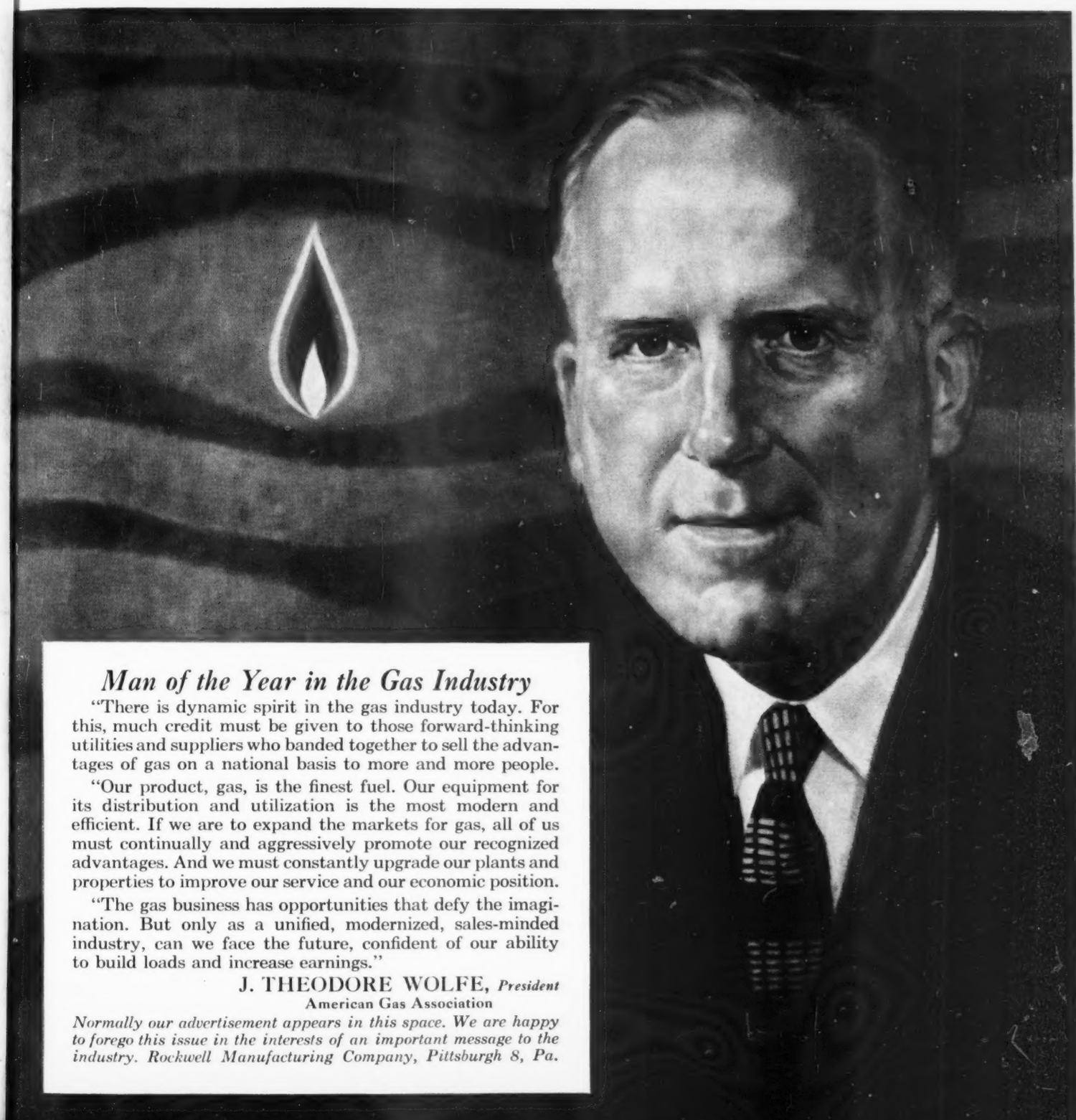
American Gas Journal

1859 Centennial Year 1959

ONLY MAGAZINE EDITED EXCLUSIVELY FOR THE GAS DISTRIBUTION INDUSTRY

FEBRUARY 1959



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"There is dynamic spirit in the gas industry today. For this, much credit must be given to those forward-thinking utilities and suppliers who banded together to sell the advantages of gas on a national basis to more and more people.

"Our product, gas, is the finest fuel. Our equipment for its distribution and utilization is the most modern and efficient. If we are to expand the markets for gas, all of us must continually and aggressively promote our recognized advantages. And we must constantly upgrade our plants and properties to improve our service and our economic position.

"The gas business has opportunities that defy the imagination. But only as a unified, modernized, sales-minded industry, can we face the future, confident of our ability to build loads and increase earnings."

J. THEODORE WOLFE, *President*
American Gas Association

Normally our advertisement appears in this space. We are happy to forego this issue in the interests of an important message to the industry. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

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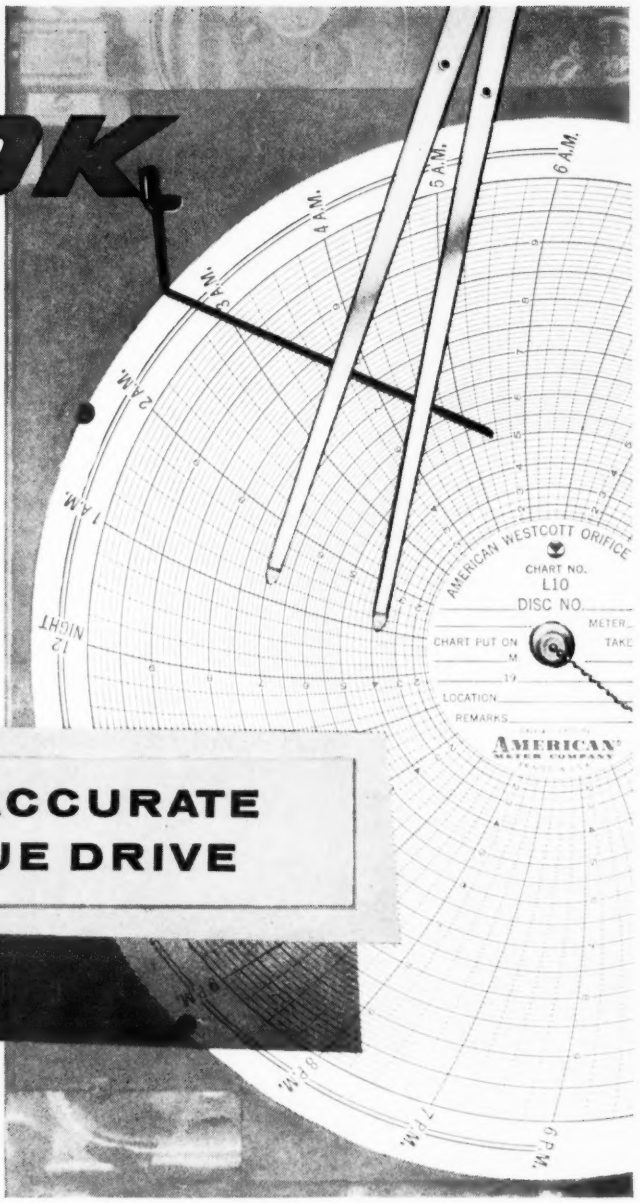

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CENTENNIAL YEAR

American Gas Journal

ONLY MAGAZINE EDITED EXCLUSIVELY FOR THE GAS DISTRIBUTION INDUSTRY

PILOT.. ..LIGHTS

Energy — Part 1

Fuel cells are being hailed as possible power supply sources for satellites and space ships. It's even hinted that they may have practical domestic use. Far-sighted gas industry seers have long seen the fuel cell as the energy device of the future. In this issue, AGJ summarizes what the fuel cell is and does, and what it may mean to the gas industry.

*

Energy — Part 2

In our January issue "Century Ahead" report, it was suggested that the gas industry might have to change its name in the not-too-distant future to more accurately reflect its purpose. Mr. D. A. Campbell, engineering and research vice president for Eclipse Fuel Engineering, has coined a new word that fits the cause like an old shoe — *ENERGAS*. He notes that *ENERGAS* could be adopted at the beginning of the conversion to an energy program . . . and would prompt people to see our industry as a key segment of the overall energy industry. We like it. Mr. Campbell is to be congratulated.

*

Rally 'round the Roundtable

Beginning in this issue is a new feature, appropriately entitled *"Roundtable"* that will present discussions on any and all topics of current interest, analyze trends, and review important developments. *"Roundtable"* is just what it says — a monthly "fuel for thought" forum open to one and all. If you have a question or want a problem aired, write and tell us . . . send it to our *"Roundtable"* Editor, *American Gas Journal, Box 1589, Dallas 21, Texas.*

*

Next Month

Corrosion costs the gas distribution industry untold millions each year . . . and a constant battle is being waged to combat corrosion and reduce this huge annual expense. Details of the war against corrosion are highlighted in the March issue's special "Corrosion Report."

*

Editorial Index Now Available

Readers desiring a copy of the annual index to Volume 185 (January-December 1958) of AGJ can obtain a copy by writing to: *Department AI, American Gas Journal, Box 1589, Dallas 21, Texas.* Be sure to address your request to this department so that it will receive prompt attention.

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M C F

NEWS HILITES OF THE INDUSTRY

Closer look at "direct sales" to industrial customers by interstate pipeline companies will be made by at least two states in 1959. **In Wyoming,** a bill has been introduced to place local sales to large industrial users by interstate pipelines under regulation of the state Public Service Commission. One of the bill's sponsors, Sen. Frank C. Mockler, says legislation is aimed at helping local distribution companies fight "invasion" of their service areas by pipeline companies. (Direct industrial sales of interstate pipeline companies are not regulated by the FPC.) **In Colorado,** state PUC has ordered Colorado Interstate Gas Company to submit to state regulation on its direct industrial sales. An estimated 25 to 35 percent of CIG's business in Colorado is on a direct sales basis, principally to steel firm Colorado Fuel and Iron Company, one of the state's largest employers.

Natural gas producers and gas transmission companies fared well during 1958 on the stock market in terms of price action, compared to the Dow Jones Industrial average according to a study by the oil and natural gas department of Empire Trust Company, New York City. The DJ averages for 1958 increased 34 percent while five major natural gas producers increased 38.8 percent and 15 gas transmission firms showed gains of 44.9 percent. Two of the latter companies did exceptionally well, with gains of 78 and 101 percent.

Public utilities are still taking a beating on the question of reimbursement of costs incurred in moving facilities necessitated by federal interstate highway construction; latest reports include: **In New Mexico,** a 1957 law requiring the state to reimburse public utility companies was ruled unconstitutional November 14 by the State Supreme Court . . . **In California,** the State Supreme Court in a 4-to-3 decision has held that a public utility must pay cost of moving facilities in streets to make way for storm drains. Court ruled that, when a utility accepts franchise rights in public streets, it is subject to an "implied obligation" to move its facilities when asked by public agencies . . . **In Arkansas,** a Legislative Council committee report has recommended that no legislation be enacted to reimburse public utilities for relocatior. of facilities . . . **In Tennessee,** the state Supreme Court has overruled petitions for a rehearing on its September ruling that a 1957 public utility reimbursement law was unconstitutional.

Transition to the modern era of natural gas has been completed by Michigan Consolidated Gas Company. Keeping in step with progress, the company's "Production Department" has been renamed the "Gas Distribution Department." For many of its 108 years, Mich Con manufactured gas for its customers, and with the recent demolition of its standby gas manufacturing plants, the changeover to natural gas has been completed and recognition has been given to the important role of gas distribution.

U. S. Supreme Court has refused to reconsider its December 8 decision on the "Memphis Case," as petitioned by the City of Memphis and Mississippi Valley Gas Company. The court simply denied the request and gave no reasons for the denial.

Underground storage plans of Washington Gas Light Company are still being stymied by a group of about 35 property owners who have refused to allow the gas utility to store gas under their property. At the area under question — in southern Prince Georges County of Maryland — 327 landowners so far have signed up and about 40 more, including the state and federal governments, have indicated willingness to sign. The utility, however, doesn't have power of eminent domain to force the "holdouts" to sign up . . . and has asked the Maryland Assembly to grant it such powers by legislative action.

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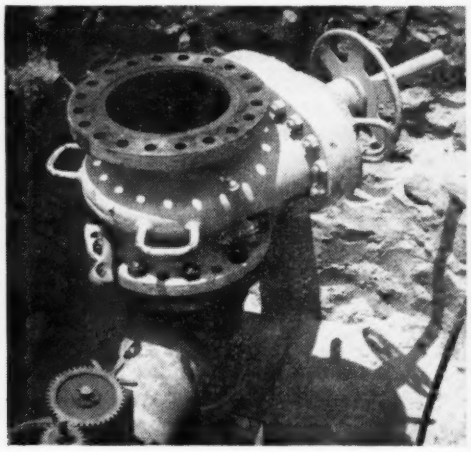
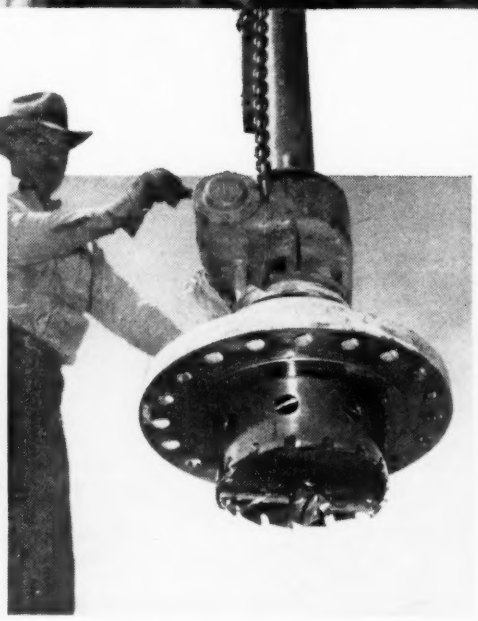
Relocating a 10″ line . . . SAFELY!





1. attaching fitting

First, the two halves of the line stopper are fitted around the line and tack welded together.

The stopper fitting is then rotated to a vertical position and welded to the line. Pressure testing the completed installation checks the welds for leakage.

2. the gate valve

Next, a Mueller gate valve designed specifically for line stopping operations is bolted to the line stopper fitting. The gate valve is the prime control feature in Mueller No-Blo operations.

3. coupons intact!

A Mueller C1-36 Drilling Machine makes short work of cutting through the 10″ line. Auxiliary air or gasoline engine drives power the cutter automatically. Upon completion of the cut, the shell cutter is retracted, the gate valve closed and the drilling machine removed.

Note the coupons contained in the shell cutter. A special ball detent on the pilot drill makes sure the coupons are retained in the cutter during retraction.

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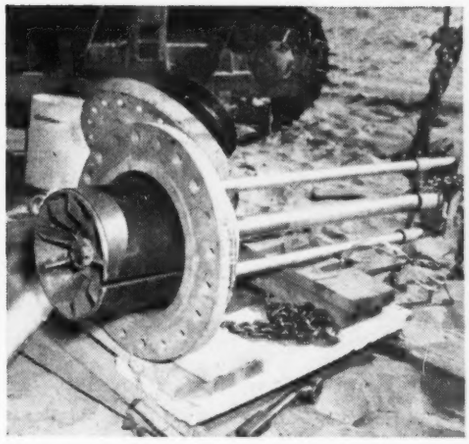
If you have any 2″ through 12″ line relocations, tie-ins or other operations requiring stop-offs, contact Mueller Co. for complete engineering service on your particular application. Write for complete information on the Mueller NO-BLO® Method and Machines.

a growing reason for
relocating gas lines!

...interchanges, highway relocation and wider rights-of-way, required by the new Interstate Road Program, are causing many gas companies to relocate gas lines, to make way for the new highway network. ■ It is a simple matter to relocate lines, make tie-ins or to make repairs while the line is under pressure. Mueller Line Stopper Units are used to stop-off the line, and if necessary, completely isolate a line section. An independent by-pass, installed ahead of the stop-off maintains uninterrupted flow during the entire operation. Relocation, repair or tie-in is completed in absolute safety, without escape of gas. ■ Mueller Line Stopper Units and companion Drilling Machines are available for pipe sizes 2″ through 12″. Contact your Mueller Representative or write direct for complete information.

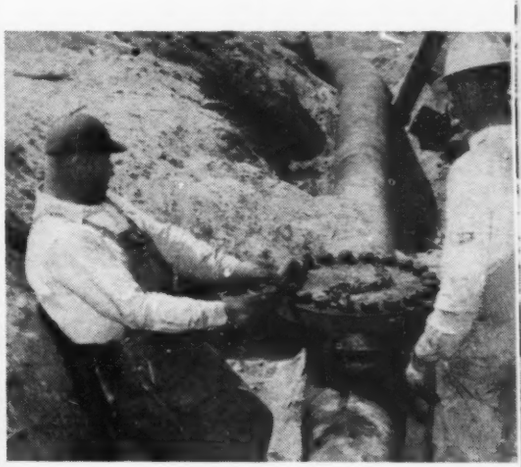


4. ready for insertion!

Here's the precision made Mueller steel wedge stopper installed on the line stopper machine ready for insertion and stopping off. The expandable stopper will slip into the precision cut made in the main by the C1-36 and shell cutter.

5. lower away!

Balanced pressure upstream and downstream from the line stopper fitting makes insertion of the steel wedge stopper easy. The Mueller Line Stopping Machine guides the stopper into place and then expands the stopper, forming a solid, gas-tight plug in the line as by-pass line carries the flow.



6. bolt 'em down!

After the lines have been relocated, the steel wedge stopper is removed, quickly activating the new line, safely and easily. Removal of the Line Stopper Machine and insertion of the special Mueller balanced pressure completion plug into the line stopper fitting paves the way to the final step. Stout steel bolts securely anchor the completion cap in place, finishing the stop-off operation.

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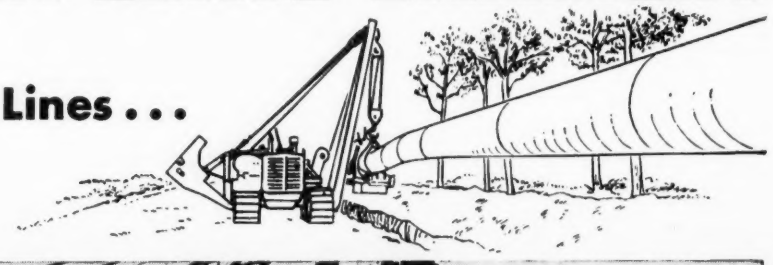

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MANY of the nation's major gas transmission lines are protected from underground corrosion with *Pitt Chem* Coal Tar Pipeline Enamels. No other material can *begin* to match coal tar's *proven* record of economical, long-lasting protection.

So make a point to specify this *same* guaranteed protection for your distribution lines. *Pitt Chem* Pipeline Enamels are your *best* assurance against pipeline failure which can be extremely costly, particularly in metropolitan areas.

Pitt Chem Enamels are manufactured by a basic producer, and are rigidly quality-controlled at every step of production to meet *published* specifications. • Call on a *Pitt Chem* man to help you plan *your* next distribution line protection program. He's fully equipped to give you valuable technical assistance . . . and to guide you to long-run protection economies.

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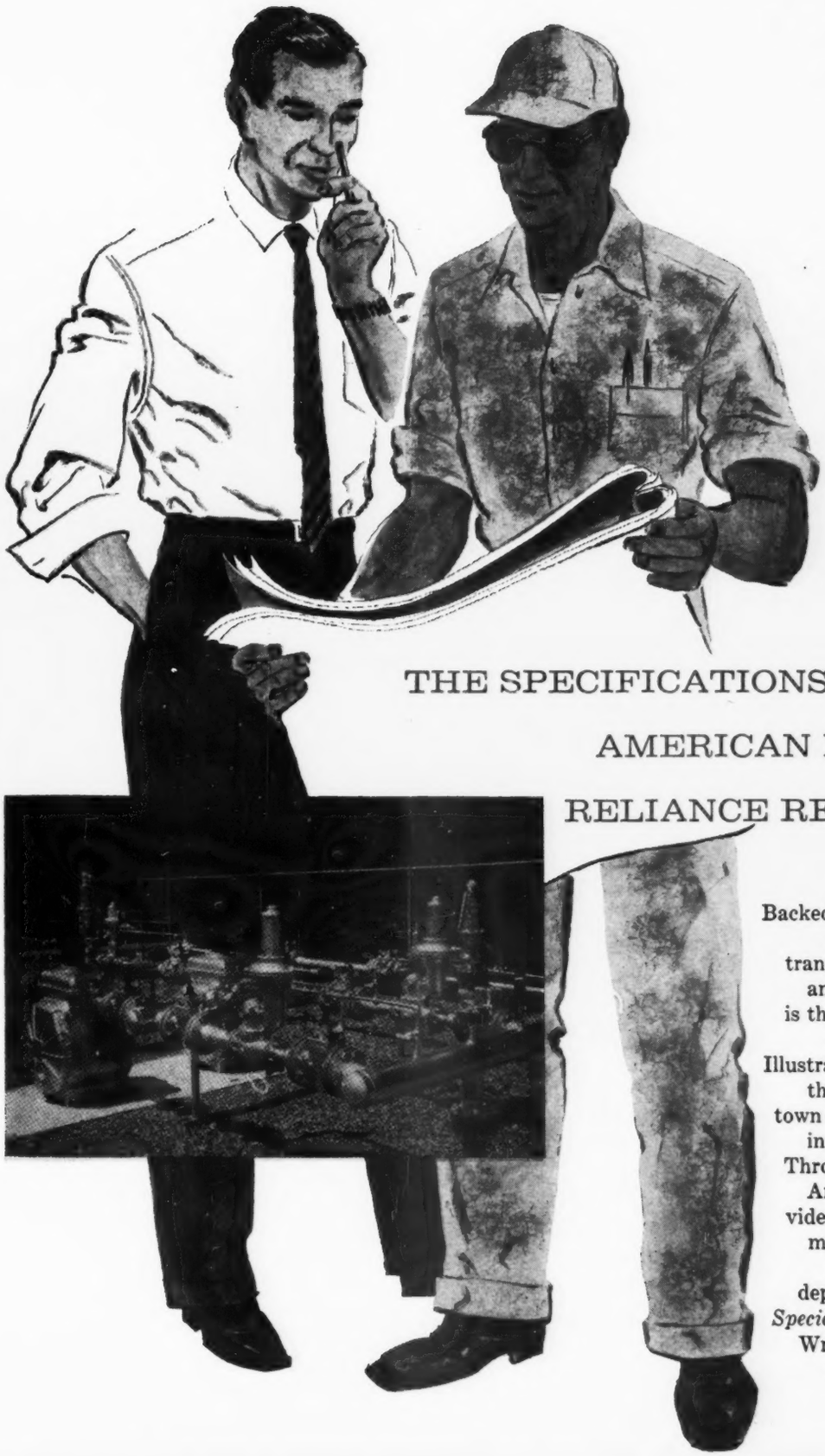

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RELIANCE
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NEWSREEL

SHARP ACTION IN NEW YORK to discourage use of "charcoal broiled" in advertising unless charcoal is actually employed has provoked the American Gas Association to suggest use of a new term, *"Hearth Broiled"* as a more realistic identification of all types of broiled items regardless of the type of gas equipment used. The New York Commissioner frowns on use of "char-broiled," "charkist" or any word with the prefix "char," noting that use of such terms infers that charcoal is used for broiling. Anticipating similar action in other cities by municipal authorities, A.G.A suggests that use of "hearth broiled" by restaurant owners be promoted universally by the gas utilities.

UNION GAS COMPANY OF CANADA has established two new districts and relocated boundaries of five existing districts. Division of its operating area into seven districts was prompted by Union's recent expansion into new areas; the acquisition of a major portion of Dominion Natural Gas Company's properties in Southwestern Ontario, and the transfer of franchises for distribution by City Gas Company of London to Union. One of the two new districts, headquartered at Simcoe will include Tillsonburg, Caledonia, Dunnville, Delhi, Selkirk, Port Dover, and Hagersville; the other new district at Brantford will serve Woodstock, Galt, Ingersoll, Preston, Hespler, Paris, and Ancaster.

When Soviet First Deputy Premier Mikoyan visited a Howard Johnson restaurant in New Jersey during his recent travels in the U.S., he was given a tour of the eating establishment's kitchen. Mikoyan asked the restaurant's assistant manager "why does the kitchen use gas instead of electricity?" The reply was simple — "the electricity sometimes fails!"

NORTHERN ILLINOIS GAS COMPANY has created a new division in a recent realignment of its service territory. The new "eastern division," which includes 58 communities along the Indiana state line from Chicago city limits to south of Kankakee, was formerly a part of the southern division headquartered in Joliet. New division headquarters will be in Blue Island until new facilities to be built this year are completed in Glenwood. Donald B. Miller, former district manager of the Blue Island-Harvey-Chicago Heights-Kankakee area, has been appointed manager of the new division.

JACOB R. V. M. LEFFERTS, of Oak Hill Builders, Inc., received the 1958 Gas Industry Builder Achievement Award at the National Association of Home Builders convention held in Chicago in January. The award, initiated last year by the gas industry, was presented by C. S. Stackpole, managing director of the A.G.A. The New Jersey builder won national attention during 1958 with one of the new all-gas homes in his 650 unit Oak Hill development near Red Bank. The house includes 11 gas appliances with 17 fuel applications.

NORTHERN NATURAL GAS COMPANY, Omaha, Nebraska, and Air Products, Inc. of Allentown, Pennsylvania, have formed a new company to extract helium from natural gas. The new firm, Helex Company, will be the first privately-operated facility in this country for extraction of helium from gas in transmission systems. At present, all other helium plants in the U. S. are operated by the Bureau of Mines. Construction of a $13,500,000 extraction and purification plant near Sunray, Texas, will begin as "quickly as possible." The plant will process 120,000,000 cu ft of natural gas per day to yield in one year some 260,000,000 cu ft of helium as compared with the total 1957 U. S. output of 292,000,000 cu ft.

NATURAL GAS SERVICE COMPANY of Fredericksburg, Virginia, has become the 120th company to be exempted from Federal Power Commission regulation under the Hinshaw Amendment to the Natural Gas Act.

RESIDENTS OF WAVERLY, IOWA, appreciate the efficiency of privately-owned gas company operations. The town recently voted overwhelmingly in favor of renewing the 20-year natural gas franchise of Iowa Public Service Company. The vote was 1121 to 7. Waverly has been served natural gas for the last four years. Before that, propane gas was piped into the community by IPS.

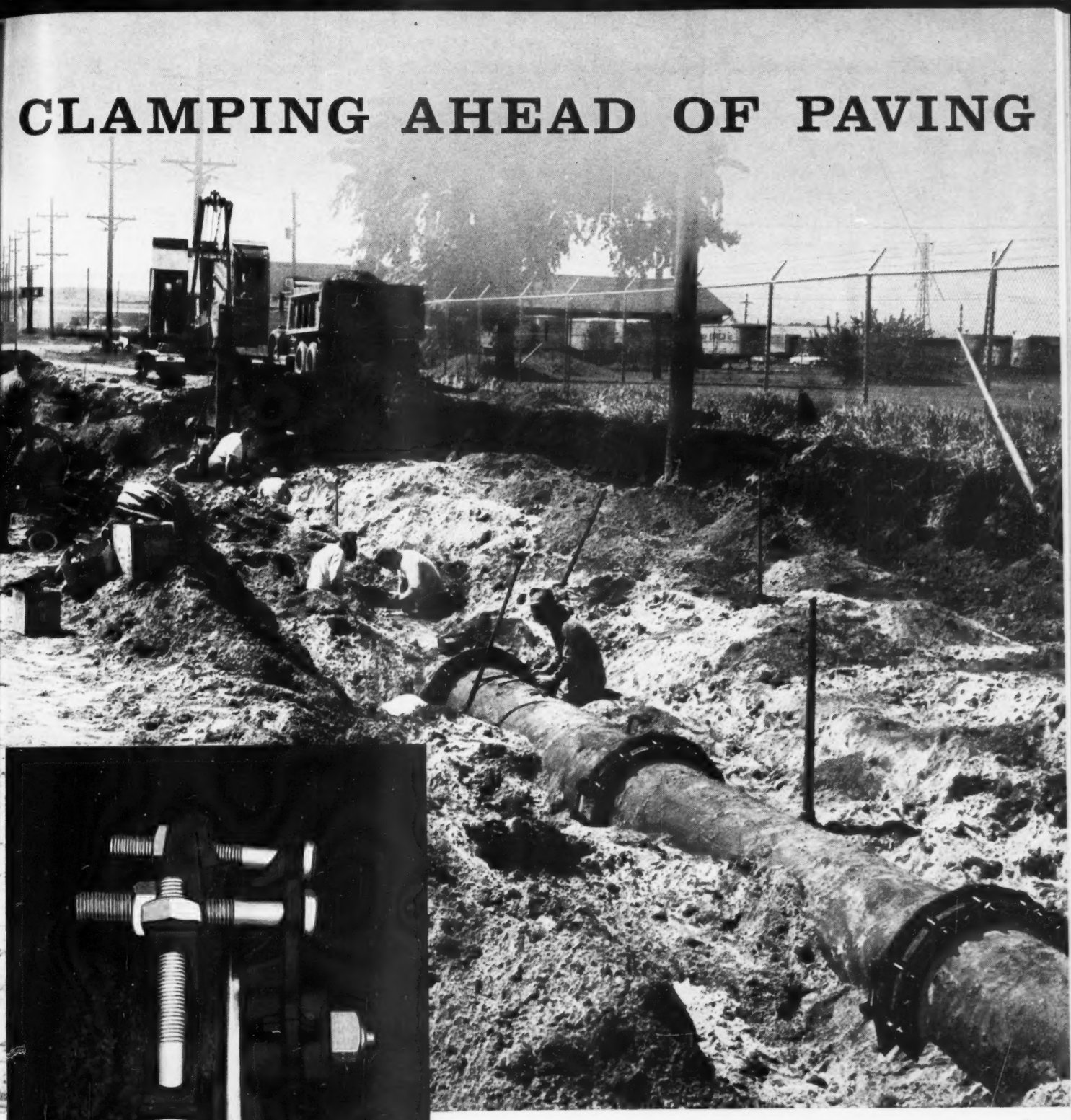
PACIFIC GAS AND ELECTRIC COMPANY is developing a second underground natural gas storage project in the McDonald Island gas field west of Stockton, California, to help meet peak day demands. Natural Gas Corporation, a PG&E subsidiary, has acquired all rights and interests in the McDonald Island field, including 11 wells and an 18-in. main and related equipment connecting the field to PG&E's system from Standard Oil Company of California, in exchange for substantially all of Natural's mineral holdings in the Rio Vista gas field of the Sacramento delta area. The value-for-value exchange involved no money. PG&E is also going ahead with development of a natural gas storage project at Pleasant Creek field near Winters. Authorizations to place both storage fields in operation will be requested soon of the California Public Utilities Commission.

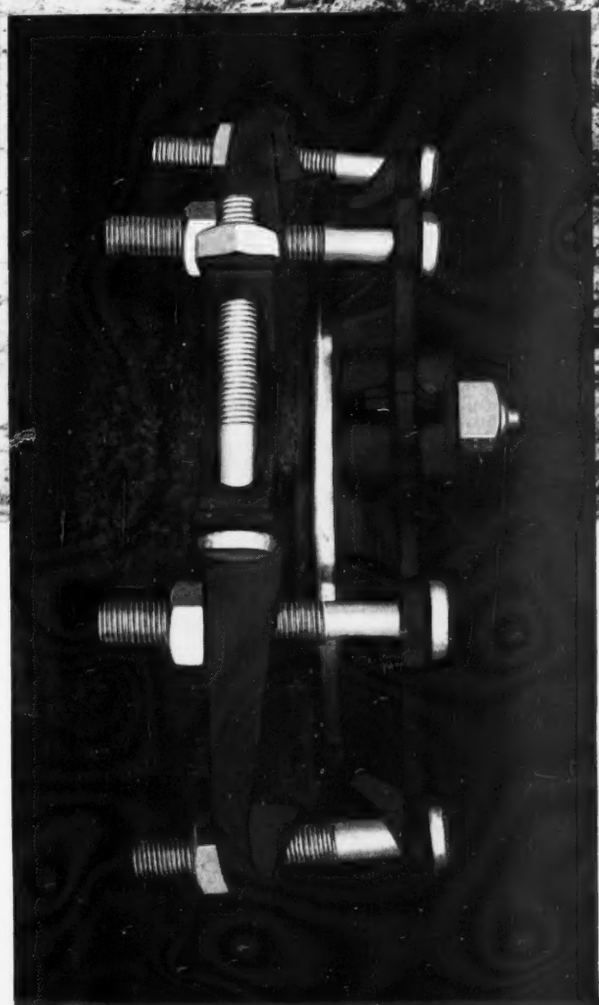
An increase of 3.5 percent in the amount of gas used by electric utility plants for generation of electricity was recorded in the 12 months ended November 30, 1958, reports the FPC. During the same 12-month period, a 4.9 percent decrease in coal consumed and a 6.7 percent decrease in oil consumed was registered. In all, during the 12-month period, the electric utilities fired their boilers with 1.373 trillion cu ft of gas. Most of this was natural gas with only a minor amount of other types of gas used.

Southern Union Gas Company's new $50,000 headquarters in Flagstaff, Arizona, has 5000 sq ft of floor space, houses both local and Arizona district offices, and features "drive-up" window for customers to pay bills.

Newest gas refrigerator, the "Kirk," is inspected by noted industrial designer Russel Wright, left, and K. C. Kirkorian, president, and L. J. Jiskoot, board chairman, Kirk Industries, Inc., right. New refrigerator has A.G.A. Laboratories approval, is part of line of 5.5 to 14 cu ft models now in production at South Norwalk, Connecticut.

CLAMPING AHEAD OF PAVING





More and more, clamping bell and spigot joints ahead of paving is becoming standard practice around the country.

When you clamp with the Skinner-Seal Bell Joint Clamp, you get massive malleable iron construction, gaskets sealed by monel band, oversize corrosion resistant bolts.

For over 50 years, our clamps have been built for permanence. Every detail of design and construction is worked out with that in mind.

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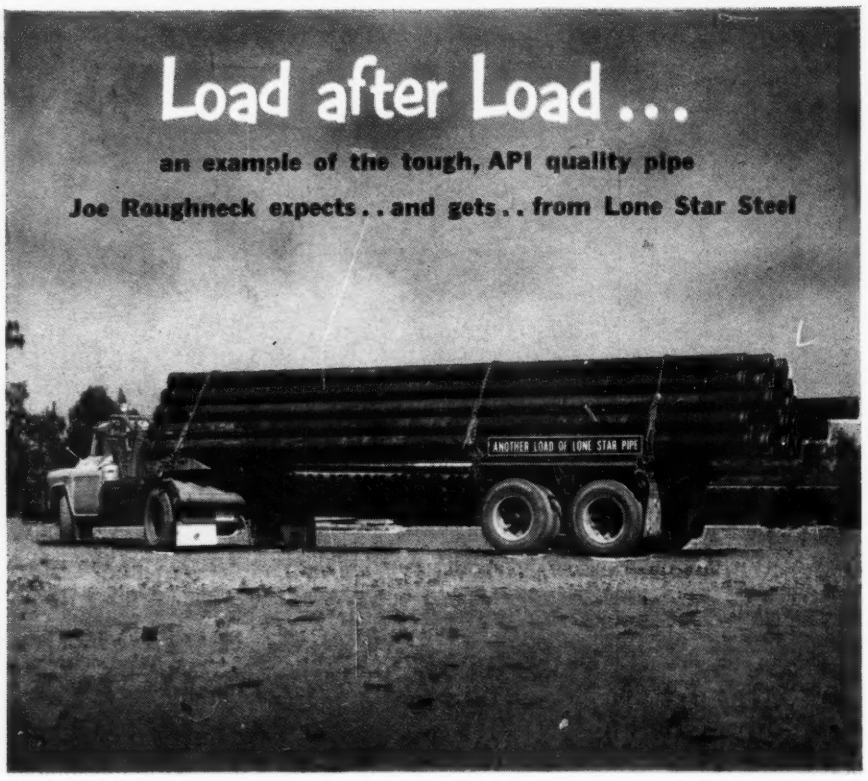
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Joe Roughneck expects..and gets..from Lone Star Steel
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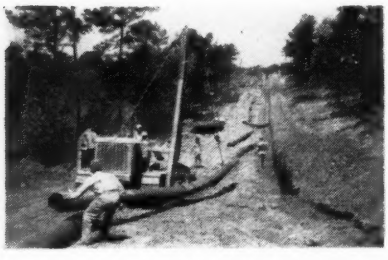
In the heart of the oil country, Lone Star Steel's huge plant is Joe Roughneck's solid source of supply for API casing, tubing and line pipe. Quality-controlled from mining of ore to finished pipe.. Lone Star electric weld pipe meets strict API specifications. Fully normalized, of course.



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NEWS

JOHNS-MANVILLE has acquired assets and the going business of L. O. F. Glass Fibers Company to become a major competitor in the nation-wide fiber glass industry. Johns-Manville Fiber Glass Inc., a wholly-owned subsidiary of Johns-Manville Corporation, has been formed to manage the seven fiber glass plants and a fiber glass research and technical center at Waterville, Ohio, formerly operated by L.O.F. R. H. Barnard has been elected president of the new subsidiary, the same post he held with L.O.F. F. H. May, Jr., formerly vice president, secretary and treasurer of L.O.F., has been elected vice president and general manager. The new J-M subsidiary will become the 10th operating division of Johns-Manville.

ECLIPSE FUEL ENGINEERING COMPANY has purchased Norwalk Valve Company of South Norwalk, Connecticut, leading manufacturer of gas pressure and control equipment. The second acquisition announced by Eclipse in the last year, purchase of the 80-year-old firm represents another step in Eclipse's continuing expansion and diversification in the combusion, boiler, and related fields. Machinery, tooling, engineering files, and inventory, all included in the sale, are being moved to the main Eclipse plant in Rockford, Connecticut, and manufacturing and sales activities will be carried on under the designation of Norwalk Valve Division, Eclipse Fuel Engineering Company.

SASKATCHEWAN POWER CORPORATION'S 1959 gas expansion plans will complete the firm's program to provide every city in Saskatchewan with a natural gas distribution system. Latest plans include installation this year of a distribution system in Yorktown, at a cost of $550,000.

A NEW COMPANY, Tejas Plastic Supply Company has been formed in Fort Worth, Texas, to specialize in manufacture and distribution of plastics used in the prevention of corrosion of underground pipes and fittings. R. B. Bender is president of the newly-formed North Texas firm.

CUTLER-HAMMER has broadened its field marketing organization by increasing its number of district sales offices from 17 to 22 and establishing five regional sales districts. The 22 sales districts have been divided into Eastern, Central, Southern, Midwestern, and Western regions. J. P. Simon has been appointed Eastern regional sales manager; O. P. Proudfoot, Central regional sales manager; E. A. Clark, Southern regional sales manager; R. A. Haworth, Midwestern regional manager; and R. C. Seibert, Western regional sales manager.

A. O. SMITH CORPORATION has formed a new reinforced plastics division to manufacture reinforced plastic pipe and other plastic products for application in the gas industry. James F. Donnelly, Sr., former assistant to the executive vice president, has been named general manager of the new division. More than five years have been spent by Smith's research laboratories developing and field testing reinforced plastic pipe and various other plastic applications.

ROUND TABLE

Monthly Forum on Fuel for Thought

1947-1957: Era of Many Significant Changes

How has the great "transition" from manufactured to almost full natural gas service — in the 1947-1957 era — affected the gas industry?

There have been many significant changes reflected in the important statistics covering number of customers served, sales, revenues, average annual usage, average annual revenue, and average annual rates, reports Michael J. Kraemer, executive consultant with Commonwealth Services.

Kraemer has prepared a comprehensive study covering all gas utilities and specifically, the phenomenal growth of the natural gas utility companies. Included in the report are average annual usage, the average annual revenue, and the average annual rates, all compiled from data of the American Gas Association.

Growing importance of natural gas is reflected in 1957 total sales by the natural gas utilities; on a therm basis, they accounted for 97 percent of all utility gas sales (latter includes natural, manufactured, mixed gas, and liquefied petroleum). In 1947, the corresponding ratio was 87 percent.

Customer growth can be seen in the increase of the average number of customers served by the gas industry, which rose from 21,400,000 in 1947 to 30,500,000 in 1957, an increase of 9,100,000 or 42 percent. During this same period, customers served by natural gas utilities rose by 165 percent, while the number of customers served with manufactured or mixed gas declined markedly.

Average Number of Customers — All Classes

	1957	1947	Increase
1. All Gas Utilities	30,476,000	21,417,000	42%
2. Natural Gas Utilities	27,046,000	10,189,000	165
Ratio of Item 2 to Item 1	89%	48%	

By way of comparison, during the same period, the number of customers served by the electric utility industry rose from 38,400,000 in 1947 to 55,200,000 in 1957, an increase of 43 percent and only one percentage point greater than the rate of increase registered by the gas utilities.

The number of residential customers served by all gas utilities also rose by 42 percent in the 1947-57 period—and residential customers of the natural gas utilities increased by 167 percent.

Average Number of Residential Customers

	1957	1947	Increase
1. All Gas Utilities	28,101,000	19,835,000	42%
2. Natural Gas Utilities	24,902,000	9,336,000	167
Ratio of Item 2 to Item 1	89%	47%	

Statistical data from A.G.A. on gas house heating customers of all gas utilities is not available for the years prior to 1949; no figures are available, either, on natural gas house heating customers for any period, making it necessary to estimate such statistics.

From the data that is available, however, some very interesting facts appear:

(a) Between 1949 and 1957, the gas utilities added nearly 10,000,000 residential house heating customers. Indications are that natural gas utilities picked up more than 9,000,000 residential house heating customers over this span of years.

(b) There has been a marked increase in residential house heating saturation points; however, nearly 11,000,000 of the residential customers of the gas industry in 1957 were not house heating customers, evidence that there is room for considerable growth in this direction.

(c) In 1957, about 61 percent of the residential customers of the gas industry were heating with gas, compared with 35 percent in 1949.

	All Gas Utilities	
	1957	1949
Total Residential Customers	28,101,000	21,264,000
Total House Heating Customers	17,188,000	7,433,000
Theoretical Saturation Point	61%	35%

Assuming that 95 percent of the house heating customers burning all types of gas were consuming natural gas in both 1957 and 1949, the theoretical residential house heating saturation points of the natural gas segment of the business would compare as follows:

	Natural Gas Utilities	
	1957	1949
Total Natural Gas Residential Customers	24,902,000	11,409,000
95% of All Residential Customers Using Gas for House Heating	16,329,000	7,061,000
Theoretical Saturation Point (Est.)	66%	62%

If the above figures are adjusted (for statistical purposes), assuming that all of the house heating customers of the gas industry were burning natural gas in both 1957 and 1949, the house heating saturation points of the natural gas industry would be 69 percent and 65 percent in the respective years.

House heating load is of major importance, emphasizes Kraemer's report. A typical family of four persons will consume about 100 therms (10 Mcf) per annum for cooking, and about 300 therms per annum for water heating. House heating adds greatly to this. In the colder climates, gas consumption for house heating will run well in excess of 2000 therms per annum; and this would range downward to a more modest figure in warm weather areas.

Sales in therms and revenues have also increased greatly. Total sales of gas to all classes of customers rose from 29.9 billion therms in 1947 to 77.4 billion in 1957, an increase of 159 percent. Simultaneously, operating revenues have increased by 197 percent.

Industrial sales are of the greatest single importance on a volume basis. In terms of revenues, however, residential sales account for the highest percentage of the total.

Sales — All Gas Utilities

	Billion Therms		Percent	Percent of Total	
	1957	1947	Increase	1957	1947
Residential	25.98	10.08	158%	33.6%	33.6%
Commercial	6.99	3.11	145	9.0	10.4
Industrial	40.48	15.79	156	52.3	53.0
Other	3.95	.90	339	5.1	3.0
Total	77.40	29.88	159%	100.0%	100.0%

Revenues — All Gas Utilities

	Millions		Percent	Percent of Total	
	1957	1947	Increase	1957	1947
Residential	$2,379	$ 861	176%	57.4%	61.7%
Commercial	505	191	164	12.3	13.7
Industrial	1,150	326	253	27.8	23.3
Other	102	18	466	2.5	1.3
Total	$4,136	$1,396	197%	100.0%	100.0%

Note: Volume figures are expressed on a therm basis.

Kraemer points out that more than 85 percent of the total sales volume in both 1947 and 1957 was traceable to residential and industrial sales. This is also true revenue-wise, but the emphasis shifts from industrial to residential—notwithstanding a relatively sharp percentage increase in industrial revenues in the past decade.

Changes in sales and revenue trends of the natural gas utilities are quite significant:

Sales — Natural Gas Utilities

	Billion Therms		Percent Increase	Percent of Total	
	1957	1947		1957	1947
Residential	24.28	7.51	223%	32.4%	28.9%
Commercial	6.69	2.51	167	8.9	9.7
Industrial	40.12	15.14	165	53.5	58.1
Other	3.92	.86	356	5.2	3.3
Total	75.01	26.02	188%	100.0%	100.0%

Revenues — Natural Gas Utilities

	Millions		Percent Increase	Percent of Total	
	1957	1947		1957	1947
Residential	$2,118	$455	365%	55.8%	53.7%
Commercial	461	110	319	12.1	13.0
Industrial	1,118	269	316	29.5	31.7
Other	100	14	613	2.6	1.6
Total	$3,797	$848	348%	100.0%	100.0%

Comparing the gas industry's load and revenue derivation by classes of customers with the electric utility industry, Kraemer has produced some interesting facts:

1. Commercial sales volume of the gas industry and its percentage of total operating revenues stemming from commercial sales are relatively small.
2. Nearly 60 percent of the total operating revenues of the gas industry are traceable to residential sales; on the other hand, only about 30 percent of the electric utility industry's revenues come from residential customers.

Sales in Percent of Total — 1957

	Residential	Commercial	Industrial	Other	Total
All Gas Utilities	34%	9%	52%	5%	100%
Natural Gas Utilities	32	9	54	5	100
Electric Utility Industry	28*	17	51	4	100

Revenues in Percent of Total — 1957

All Gas Utilities	57%	12%	28%	3%	100%
Natural Gas Utilities	56	12	29	3	100
Electric Utility Industry	32*	28	31	9	100

* Includes rural.

Between 1947 and 1957, average annual usage of gas per customer (all classes) increased by 82 percent; the average rate rose by 14 percent, and average revenue realization per customer increased by 108 percent. The increase in the average revenue realization per therm of gas sold was more pronounced in the second half of the decade, even though the rate of expansion in average usage in the second half of the decade was less than in the first half.

All Gas Utilities

				Percent Increase	
	1957	1952	1947	1957 Over 1952	1952 Over 1947
Average Annual Usage (Therms)					
Residential Customers	925	727	508	27	43
Commercial Customers	3,161	2,637	2,106	20	25
Industrial Customers	306,629	269,135	73,736	14	265
All Customers	2,540	2,039	1,395	25	46
Average Rate Per Therm (Cents)					
Residential	9.15	8.40	8.54	9	2(d)
Commercial	7.23	6.51	6.15	11	6
Industrial	2.84	2.28	2.06	25	11
All Sales	5.34	4.68	4.67	14	1
Average Revenue Per Customer*					
Residential	$ 84.66	$ 61.09	$ 43.41	40	41
Commercial	228.40	171.75	129.49	33	33
Industrial	8,712.12	6,144.23	3,582.42	42	71
All Classes	135.71	95.44	65.18	42	46

*Revenue figures include rates in controversy.
(d) = decrease

During the "transition" decade, the gas utility industry has outdistanced the electric utility industry from the standpoint of rate of expansion in average usage per customer (all classes). Reflecting this factor as well as an increase in the average gas rate during a decade when the average electric rate declined, the gas industry has registered a relatively large increase in average revenue per customer.

Kraemer notes, however, that between 1952 and 1957, the electric utility industry has increased its average annual usage at a greater rate than the gas utility industry (42 percent versus 25 percent):

Utilities Growth Comparison — Gas and Electric
(All Classes of Customers)

	All Gas Utilities	Electric Utility Industry	In Relatives 1947 = 100	
			Gas	Electric
Average Annual Usage				
1957	2,540 Therms	10,214 kwh	182	175
1952	2,039	7,183	146	128
1947	1,395	5,828	100	100
Average Rate (Per Therm Per Kwh)				
1957	5.34¢	1.67¢	114	94
1952	4.68	1.79	101	101
1947	4.67	1.77	100	100
Average Annual Bill				
1957	$135.71	$170.57	208	165
1952	95.44	128.58	146	125
1947	65.18	103.16	100	100

In this analysis, Kraemer has endeavored to highlight certain statistical factors contributing to the fine growth record of the gas utility business in the past decade. In many significant respects, this record of growth compares very favorably with the electric utility industry. The record is summarized as follows:

Percentage Increases — 1957 Over 1947
(All Classes of Customers)

	All Gas Utilities	*Electric Utilities
In Customers	42%	43%
Average Annual Usage (Therms/kwh)	82	75
Average Rate—Cents (Therms/kwh)	14	6(d)
Average Annual Bill	108	65
Sales Volume	159	157
Operating Revenues	197	142

*Total electric utility industry.
(d) = decrease

From a revenue standpoint, the gas utility industry differs appreciably from the electric utility industry; the former derives nearly 60 percent of its total operating revenues from residential sales, while the corresponding figure is about 30 percent for the electric utilities.

It might be argued by one class of investors, Kraemer points out, that the revenues of the electric utilities are better diversified; on the other hand, another class of investors can just as effectively contend that the relatively high residential revenue ratio of the gas industry makes the business less vulnerable to economic recession, even though it is occasionally affected by weather conditions.

In 1957, the gas utility industry had approximately 28,000,000 residential customers, and of this number, an estimated 17 million (61 percent) were house heating customers.

Clearly, declares Kraemer, the gas business is a considerable number of customers removed from any theoretical saturation point. Development of this potential market calls for the development of additional sources of gas and attaching new space heating customers, (with additional commercial and industrial sales to sustain pipeline load factors) and never-ending vigilance and more research dollars to develop new appliances and widen the uses of gas.

In more recent years, the rate of increase in the average annual usage of electricity per customer has considerably outdistanced the experience of the gas industry.

One may conclude that—based on Kraemer's study—the gas utility industry is now on the threshold of a vast frontier of growth that awaits only action, determination, and intelligent planning to achieve conquest. ★ ★ ★

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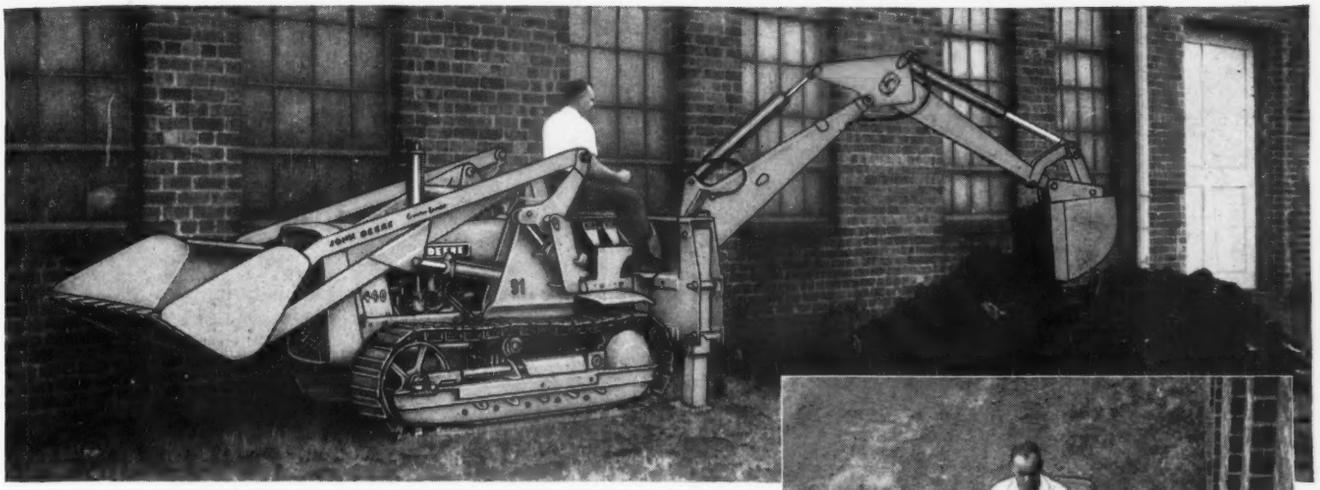

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And it's responsive, easily controlled digging power — just two control levers to operate.

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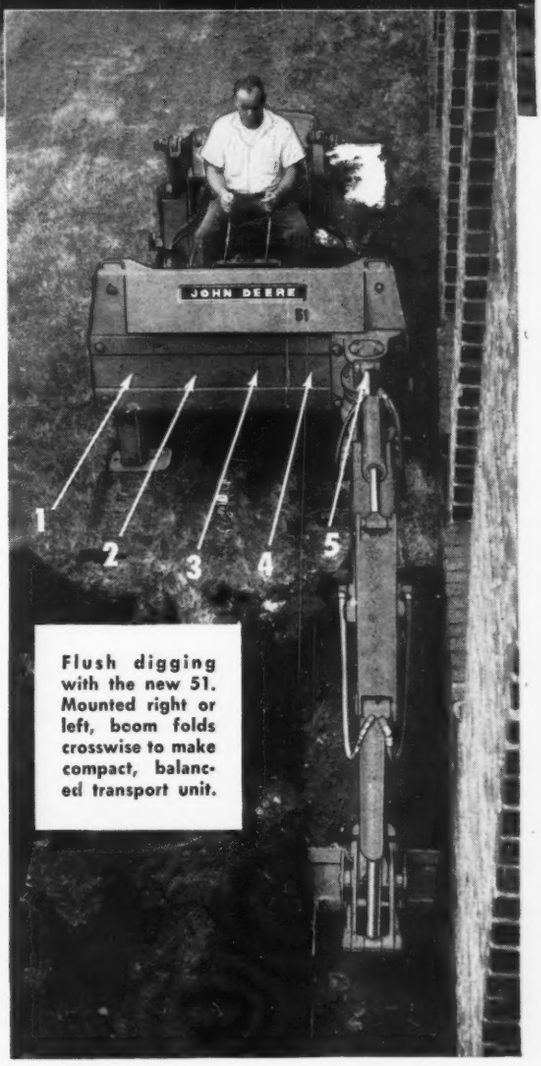

Flush digging with the new 51. Mounted right or left, boom folds crosswise to make compact, balanced transport unit.

The center-mounted John Deere 50 Backhoe has boomswing of 205 degrees, 20-foot 3-inch reach, and digs as deep as 13 feet 6 inches.

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THE IDEAL PIPE FOR GAS SERVICE

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LONG LIFE	The inherent corrosion resistance of cast iron insures maximum life without the expense and inconvenience of special wrappings or other protective devices.
AMPLE WALL THICKNESS	Suitable for direct taps into the wall of the pipe without saddles or welding . . . and for assured long life.
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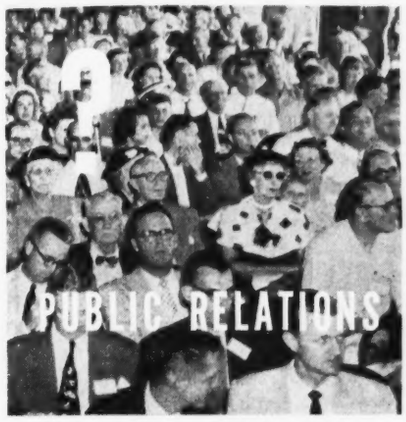
Puzzling Problems Facing The Industry . . .



. . . **better public understanding** of gas industry and its problems needed.

. . . **fast-rising costs,** slow-rising rates, declining profits pose dilemma.

. . . **producer regulation,** curtailed exploration activity threat to future.

Special Outlook Report Reveals Big Year Ahead . . .

1959: Year of Opportunity

- **Gas utility industry optimistic over continuing steady growth**
- **Expansion of facilities to zoom to meet the "boom of the sixties"**
- **Regulation, public relations, supply are biting problems**
- **Appliance manufacturers anticipating healthy sales advances**

Dean Hale, *Editor, and* **Pat Loar,** *Assistant Editor*

VIEWED FROM ATOP THE CRYSTAL BALL, 1959 seems destined to unfold as a year of steady growth for the gas industry and one in which the industry — as with most of the nation's industries — prepares itself for the anticipated "boom of the '60's."

Despite a business slowdown in 1958 that had a profound effect on a good-size segment of the national economy, the gas industry — and gas distribution companies in particular — continued to make substantial gains. At year's end, the industry confidently totaled its progress — a record breaking 32,100,000 customers, annual sales of more than $4.5-billion, and plans to spend more than $2-billion in 1959 for more improvements and additions to facilities.

Help from the weather gave the industry one of its better years. Early in 1958, severe cold weather over large areas of the country boomed gas sales, and more cold weather in the final quarter of the year added a second boost to sales.

Reversal of the "Memphis Case decision" by the Supreme Court at year's end removed the brakes from expansion plans of many companies and prompted industry leaders to look to 1959 with enthusiasm and optimism. Increased gas supplies for many present and new major market areas are visualized as being realized in 1959.

Gas distribution growth will continue to be dynamic. Highlights of what 1959 will offer can be seen in:

. . . an estimated 900,000 or more new customers to be added.
. . . 11,000 miles of new gas mains to be installed.
. . . 7000 miles of new gas services to be installed.
. . . $952,000,000 to be spent for construction of new facilities and replacements.
. . . appliance sales will be nearly 8,500,000 units.
. . . PAR program budget at record $3,770,000.
. . . Gas industry TV budget at record $3,220,000.
. . . $25,000,000 Gold Star Range promotion to boost range sales.

For the Record: Significant 1958 Gas Industry Statistics

32,100,000	**Customers on December 31**	**$4.574 Billion**	**Total Revenues for year**
11,300	**Miles of New Mains Installed**	**8,000,000**	**Appliances sold**
6880	**Miles of New Services Installed**	**$18.4 Billion**	**Value of Gross Plant on December 31**
860,000	**New Customers Added**	**264.6 Trillion**	**Cu Ft of Proved Recoverable Reserves**
79.8 Billion	**Total Sales in Therms for year**	**$2.280 Billion**	**Construction Expenditures for Year**

General business climate for 1959 appears to be characterized by similar optimism but no tremendous upsurge is seen. The year ahead is seen as one for gathering momentum — a year of transition to the 1960's when genuine boom years will develop. Industry will take advantage of cost cutting methods, better inventory control, increased efficiency modernization of facilities, and new product development to improve its position.

Optimistic on the surface, the gas industry is still plagued with problems that have no simple answer. Capital construction costs continue to rise and money for financing such construction comes at a dear price. Operating costs are still on the increase and net return (and profits) are squeezed smaller and smaller. Privately more than publicly, industry leaders are concerned over securing adequate future gas supplies. Regulation — actual and threatened — is a major producer of obstacles to efficient operation.

Finally awakening to the idea that complacency won't produce results, the industry is beginning to improve its public relations. But a vast majority of the public remains uneducated to the industry's problems . . . and the task of creating a better climate for public acceptance and understanding of industry practices and problems remains gargantuan.

Regulation—in many diverse forms—looms as a spectre over the industry:

. . . the inevitable (but needlessly so) "lag" between rate increases and boosts in cost of gas supply is getting longer, not shorter. Local and state regulatory bodies are reluctant to speed the rate adjusting processes . . . political expediency in the form of "public interest" rather than economic good sense continues to intensify the injustice . . . and lack of good public relations by the gas utilities is a major contributing factor in many cases.

. . . continuing federal regulation of gas producers has yet to receive long-needed legislative relief. Concern is growing that the delay is stifling badly needed exploration for gas reserves to bolster tomorrow's gas supplies to meet spiraling consumer demands.

. . . how and why regulatory involvements can be frustrating — and shameful — is exemplified by the recent "Midwestern" decision by FPC . . . where, after three years wrangling, everyone is "starting over" while the gas-hungry Midwest is still without adequate natural gas supplies.

. . . in Canada, the Borden Commission's theory of proposed regulation marks a radical departure from that country's past experience. If adopted, it could set back growth of the Canadian gas industry for many years. Observers believe, however, that Canada's Parliament is alert to the danger and will clear the way for the industry's growth.

. . . in the U. S., the domestic petroleum industry's economic ill health is also helping jeopardize the gas industry's future. In 1958, for the second straight year, the industry declined, as evidenced in the following table:

How Petroleum Industry Is Faring:

	1956	1957	Est. 1958	Change '58 vs '56
Active Exploration Crews	623	580	510	—18.1%
Active Rotary Rigs	2,618	2,429	1,923	—26.5%
Wildcat Wells Completed	13,034	11,739	9,600	—26.3%
Development Wells Completed	45,126	42,099	39,650	—12.1%
Oil Wells Completed*	31,158	28,164	25,450	—18.3%
Gas Wells Completed	4,115	3,912	3,700	—10.1%
Dry Holes Drilled	21,838	20,701	18,700	—14.4%
Total Footage Drilled (1000 ft)	233,902	221,901	200,000	—14.5%
Oil Production, Total (1000 BPD)	7,952	7,979	7,500	—5.7%
Shut-in Capacity (1000 BPD)	1,975	2,256	2,960	+49.9%
Net Imports (1000 BPD)	1,006	1,006	1,370	+36.2%
Domestic Demand (1000 BPD)	8,779	8,818	9,025	+2.8%

*Includes wells producing gas and oil simultaneously.

As the table shows, exploration and drilling are down, imports up, and the domestic producers of oil and gas are fighting for survival, squeezed between rising costs and declining prices and income, while subjected to unnecessary federal regulation if they are natural gas producers, and the object of unwarranted emotional attacks by publicity-seeking legislators who — along with most of the U. S. public — do not understand the industry.

What happens to the nation's oil and gas producers is of vital concern. The bulk of all natural gas consumed in the U. S. is produced by "independent producers" (meaning they aren't pipeline companies) and these producers have integrated oil and gas production operations. If their oil business skids, they reduce their exploration activities, and both oil and gas suffer. Ultimate big loser is the public.

Use of LPG by gas utilities continued to increase in 1958, primarily for peak shaving to meet demands incurred by unusually cold weather during the first quarter of 1958. Many gas distribution companies plan expansion of their LPG storage facilities in 1959 and they continue to be interested in large volume LPG storage, both aboveground and underground. More than 1.6-billion gal of storage capacity now exists. To meet increasing demands of all types of customers, LPG suppliers plan to expand the growing network of LPG pipelines and construct additional underground storage facilities in 1959.

Construction Picture for 1959*

(Millions of Dollars)

		1958	1959	Percent Change
Residential	Private	17,700	19,500	+10%
	Public	830	1,125	+36%
Industrial	Private	2,460	2,080	—15%
	Public	370	375	+1%
Commercial		3,550	3,630	+2%
Religious		865	950	+10%
Educational	Private	565	600	+6%
	Public	2,880	3,000	+4%
Hospitals	Private	605	600	—1%
	Public	400	475	+19%
Other Construction		28,574	19,965	—
Total		48,800	52,300	+7%

*Joint Estimates of Department of Labor and Department of Commerce for new construction.

Construction, particularly residential, is usually a good bellwether for gas distribution growth, and a trend toward increased housing construction established in late 1958 that promises to continue through 1959 is seen as a "good sign."

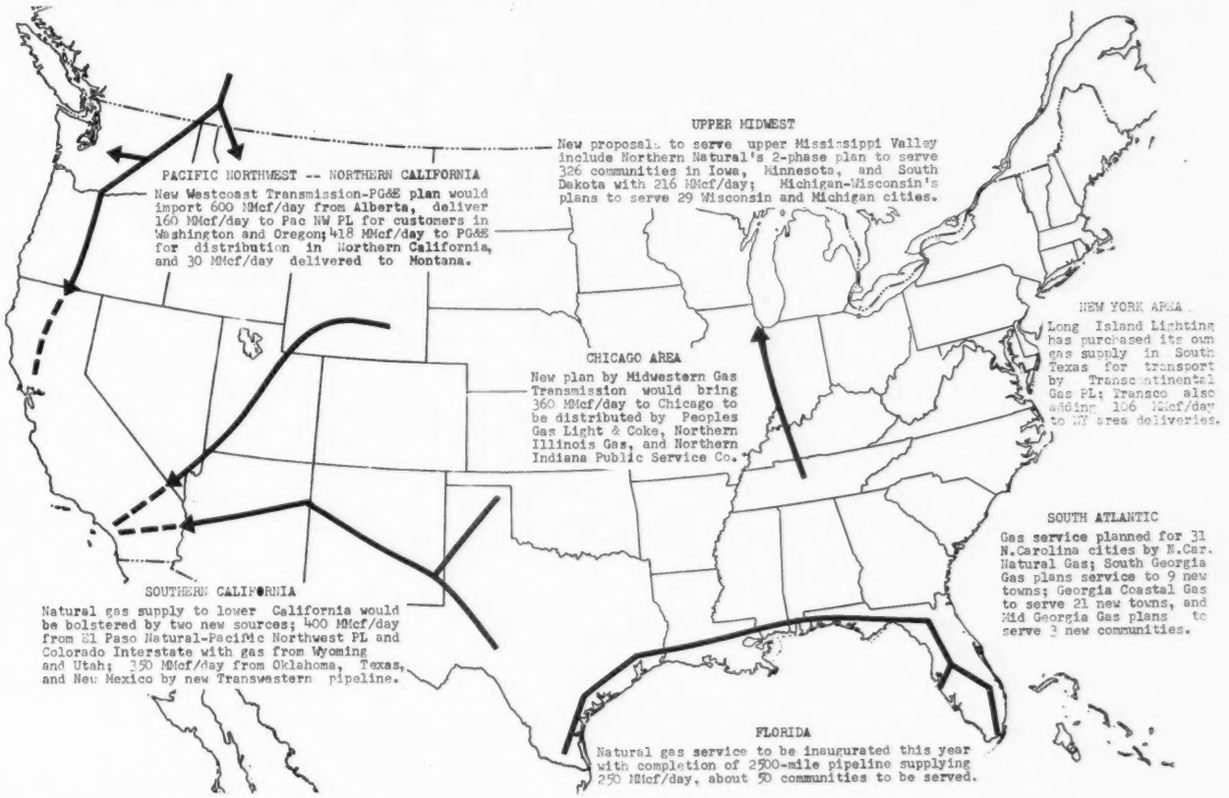
For the 11th straight year, the construction industry set a record in 1958, and practically all of the increase is attributed to gains in housing and highway construction.

During 1959, new home construction is expected to continue at a high level, and a trend toward greater volume of apartment construction established in 1958 should also continue.

Where Gas Appliances Are Being Used:

Appliance	Number In Use
Ranges	32,975,000
Water Heaters	23,100,000
Refrigerators	3,430,000
Dryers	2,250,000
Incinerators	465,000
Space Heaters	23,140,000
Central Heating Systems	10,500,000
Floor & Wall Furnaces	6,230,000
Gas Lights	300,000

Where Gas Is Growing: New Supplies for Many Areas


UPPER MIDWEST
New proposals to serve upper Mississippi Valley include Northern Natural's 2-phase plan to serve 326 communities in Iowa, Minnesota, and South Dakota with 216 MMcf/day; Michigan-Wisconsin's plans to serve 29 Wisconsin and Michigan cities.
PACIFIC NORTHWEST -- NORTHERN CALIFORNIA
New Westcoast Transmission-PG&E plan would import 600 MMcf/day from Alberta, deliver 160 MMcf/day to Pac NW PL for customers in Washington and Oregon; 418 MMcf/day to PG&E for distribution in Northern California, and 30 MMcf/day delivered to Montana.
NEW YORK AREA
Long Island Lighting has purchased its own gas supply in South Texas for transport by Transcontinental Gas PL; Transco also adding 106 MMcf/day to NY area deliveries.
CHICAGO AREA
New plan by Midwestern Gas Transmission would bring 360 MMcf/day to Chicago to be distributed by Peoples Gas Light & Coke, Northern Illinois Gas, and Northern Indiana Public Service Co.
SOUTH ATLANTIC
Gas service planned for 31 N.Carolina cities by N.Car. Natural Gas; South Georgia Gas plans service to 9 new towns; Georgia Coastal Gas to serve 21 new towns, and Mid Georgia Gas plans to serve 3 new communities.
SOUTHERN CALIFORNIA
Natural gas supply to lower California would be bolstered by two new sources; 400 MMcf/day from El Paso Natural-Pacific Northwest PL and Colorado Interstate with gas from Wyoming and Utah; 350 MMcf/day from Oklahoma, Texas, and New Mexico by new Transwestern pipeline.
FLORIDA
Natural gas service to be inaugurated this year with completion of 2500-mile pipeline supplying 250 MMcf/day, about 50 communities to be served.

In the gas appliance industry, manufacturers view 1959 as a year of increased sales volume as consumer demand strengthens. There was nothing uniform about 1958 insofar as appliance and residential gas equipment sales were concerned. Water heaters and central heating equipment had good sales volumes, while ranges and laundry equipment sales fell below 1957 volumes. In the final quarter of the year, however, sales showed definite improvement and manufacturers look for a continuation of these trends throughout 1959. The accompanying table shows 1958 appliance shipments compared to 1959 estimates.

Outlook For Appliance Sales

	1958	Est. 1959	Percent Change
Domestic Gas Ranges—Total	1,900,100	1,960,700	+3%
Free Standing	1,668,300	1,701,700	+2%
Built-In	231,800	259,000	+1.2%
Automatic Water Heaters—Total	2,621,700	2,742,100	+4.5%
Under 40 gal	1,874,500	1,903,100	+1.5%
40 gal and over	747,200	839,000	+12.1%
Central Heating Equipment—Total	1,121,000	1,165,800	+4.1%
Warm Air Furnaces	850,500	893,900	+5.3%
Boilers	121,900	128,100	+5.1%
Conversion Burners	148,600	143,800	−3.2%
Householeating—Total	1,819,600	1,865,200	+2.5%
Direct Heating Equipment	1,345,300	1,371,500	+1.9%
Recessed Wall Heaters	379,400	406,200	+7.1%
Floor Furnaces	94,900	87,500	−7.8%
Clothes Dryers (Includes combination washer-gas dryer units)	412,100	461,600	+12.0%
Incinerators	47,900	65,300	+36.3%
Gas Unit Heaters	110,100	124,300	+12.9%
Duct Furnaces	18,200	20,300	+11.5%
Commercial Gas Ranges	31,000	34,300	+10.6%
Grand Total	8,081,700	8,408,500	+4.1%

Prospects for 1959, viewed from various quarters:

. . . Judson S. Sayre, president of Norge, sees a five percent gain for durables in 1959, with automatic washers leading the pack, followed by clothes dryers and refrigerators.

. . . John Hurley, Whirlpool's sales vice president, sees an overall gain of 7 to 9 percent.

. . . GAMA views the gas refrigerator as being a factor in the 1959 market, with both Norge and Whirlpool marketing units on a big scale.

. . . T. T. Arden, president of Robertshaw-Fulton Controls, sees 1959 as a year for vigorous expansion of the market for automatic controls, and notes that his firm plans further expansion during the year to meet the expected business boom of the 1960's.

. . . 1959 looms as the best year yet for year-round gas-fired air conditioning equipment, with stepped-up local and national programs planned by utilities, manufacturers, and A.G.A.

. . . Gas range sales are destined to pick up as a result of the intensive "Gold Star" program now underway.

Increased interest by manufacturers in improving their products and producing new appliances is seen in a report from the A.G.A. laboratories. Some 5000 gas appliances and accessories were received at the laboratories and approved as complying with stringent industry performance standards.

Research activities on domestic, industrial, and commercial equipment continued at a high level, with 20 projects under study by A.G.A. The highly successful PAR (Promotion-Advertising-Research) Plan enters its 15th year in 1959 with a budget of $3,770,000. In addition, another $3,220,000 has been subscribed for the 1959 television budget, to continue sponsorship of *"Playhouse 90."*

Developments to Watch. Many new areas across the U. S. will receive natural gas in 1959 for the first time, while other markets will get big boosts in supply. What's planned and what may happen is shown in the accompanying map. * *

FUEL CELLS: *friends or foes?*

New devices produce electrical energy directly from gas at high efficiency rates; could revolutionize our energy concepts

Dean Hale, *Editor*

DIRECT CONVERSION of the chemical energy of gases into electricity has been under study in research laboratories for nearly a century, but only recently have scientists made rapid strides forward in developing workable "fuel cells."

Biggest attraction of the fuel cell is its potentially greater efficiency in converting natural fuels into electrical energy. Laboratory and pilot plant units in operation today are producing efficiencies of 65 to 80 percent, contrasted to 30 to 35 percent for steam-powered electrical generation plants.

Fuel cells, by definition, are primary electrochemical devices that oxidize a fuel and convert a substantial portion of the heat of oxidation directly to electrical energy. In a true fuel cell, fuel is supplied continuously to the negative electrode and the oxidizing agent is supplied continuously to the positive electrode, with the device thus operating continuously and producing a steady and constant output of electrical energy.

Gas industry interest in the devices centers around the fact that units under development or intensive study could use natural gas components (methane or ethane) or other hydrocarbon fuel gases. Fuel cells, while not providing a new source of energy, could serve to extend the nation's fossil fuel resources.

Types of Fuel Cells

Numerous types of fuel cells have been proposed or developed, using a variety of fuels — solid, gaseous, and liquid. Most successful types produced so far are those utilizing gaseous fuels, and these fall into two general categories:

Low and Medium Temperature Fuel Cells. These cells operate in the temperature range of 100 to 500 F, usually under pressure, and have high output only when pure hydrogen and pure oxygen are used as the fuel and oxidant, respectively.

One highly developed cell of this type operates at moderately high temperatures and at a pressure of about 600 psi.

The hydrogen-oxygen cells, while quite successful in laboratory operation, cannot be seriously considered as future major power sources due to high costs of the pure hydrogen and oxygen for use as fuel and oxidant. They are, however, of particular interest to the military for specialized applications and may find certain civilian applications.

High Temperature Cells. Probably of greatest interest and of most practical value are the fuel cells operating in the temperature range of 900 to 1600 F. Their operation is usually conducted at atmospheric pressure, using air as an oxidant and ordinary fuel gases as fuel. Several cells of this type have proven quite successful and some of them have shown steady operation at operating temperatures for periods of six months and longer.

What's Happening:

Consolidation Coal Company's high temperature fuel cell is shown in Fig. 1. Development of the cell, underway for several years, has been sponsored by the Army Signal Corps. Progress on the cell's development and details of its operation were reported by Everett Gorin and Howard L. Recht, of the firm's Research and Development Division at the 1958 annual meeting of the American Society of Mechanical Engineers.

The fuel cell developed by Consolidation is composed of two flanges separated by an electronically insulating but electrolytically conducting electrolyte matrix. The matrix is a porous magnesia refractory. It is impregnated with a molten carbonate mixture that serves as the electrolyte.

On either side of the electrolyte matrix are two porous electrodes, located in the separate gas chambers. Fuel gas is passed into and out of one of these chambers, while air passes into and out of the other chamber.

The electrode in the air chamber is

FIG. 1. Diagram of high temperature fuel cell developed by Consolidation Coal.

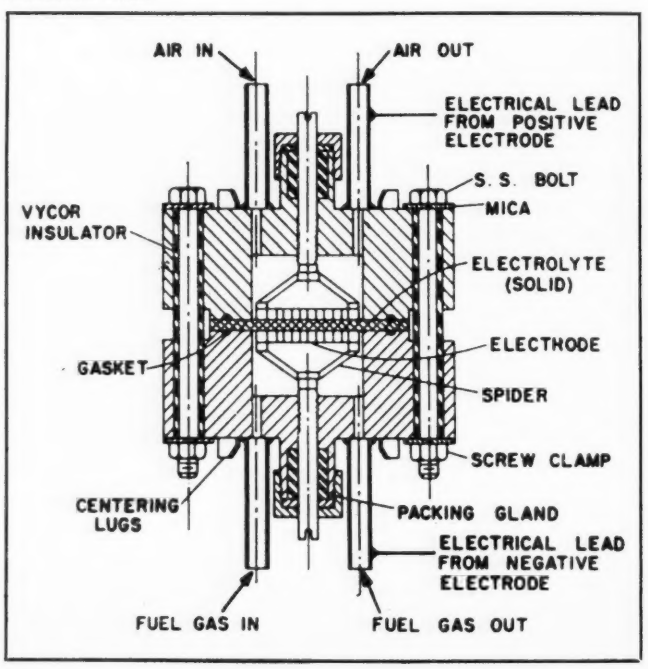
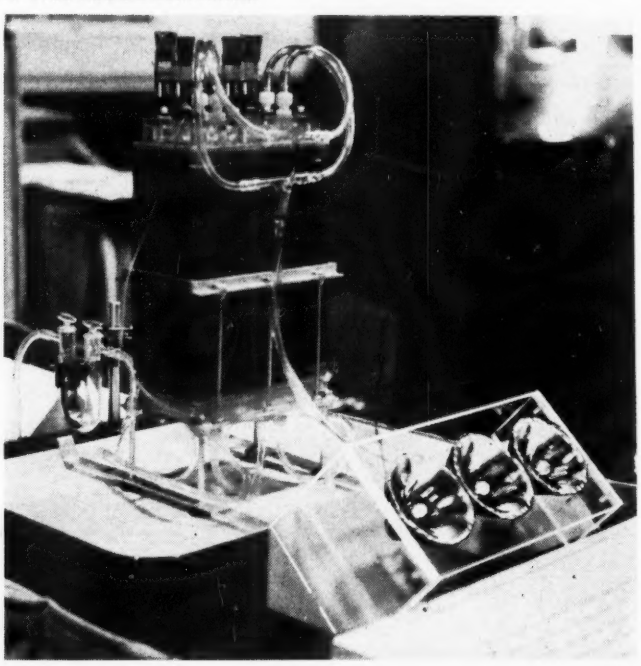


FIG. 2. Operating model of National Carbon's fuel cell was shown at 1958 A.G.A. convention.



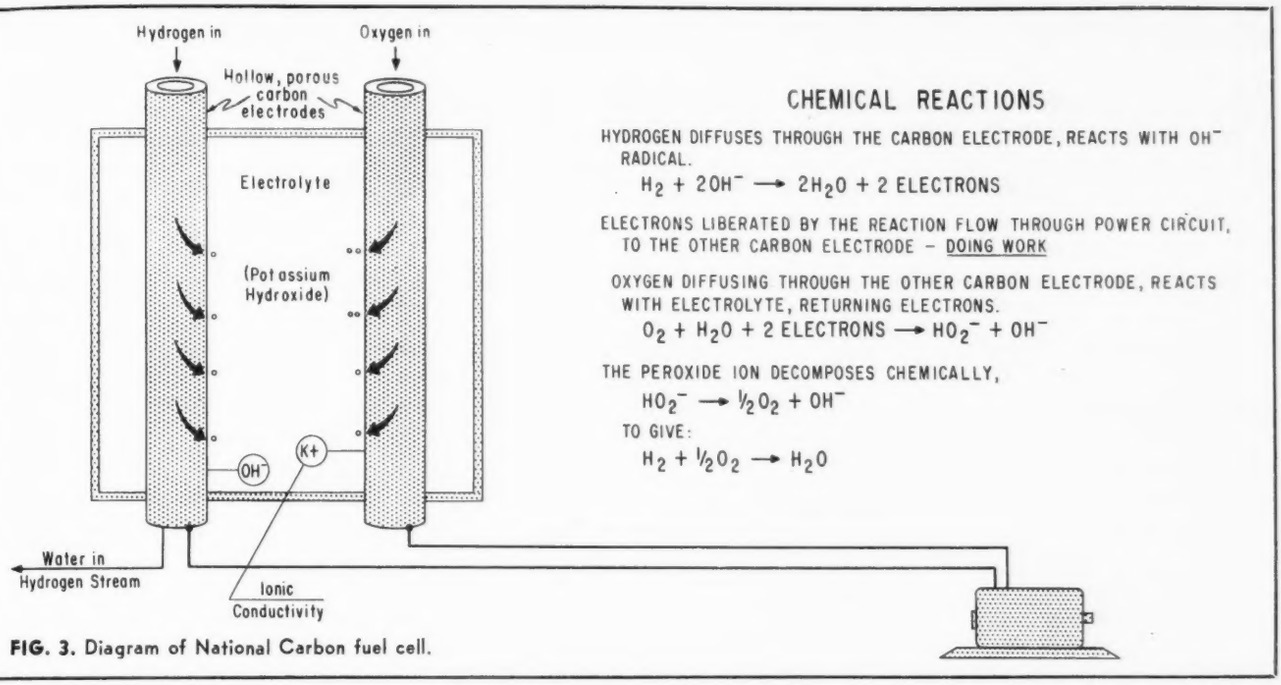

Hydrogen in
Oxygen in
Hollow, porous carbon electrodes
Electrolyte
(Potassium Hydroxide)
OH⁻
K+
Water in Hydrogen Stream
Ionic Conductivity
CHEMICAL REACTIONS
HYDROGEN DIFFUSES THROUGH THE CARBON ELECTRODE, REACTS WITH OH⁻ RADICAL.
$H_2 + 2OH^- \longrightarrow 2H_2O + 2$ ELECTRONS
ELECTRONS LIBERATED BY THE REACTION FLOW THROUGH POWER CIRCUIT, TO THE OTHER CARBON ELECTRODE – DOING WORK
OXYGEN DIFFUSING THROUGH THE OTHER CARBON ELECTRODE, REACTS WITH ELECTROLYTE, RETURNING ELECTRONS.
$O_2 + H_2O + 2$ ELECTRONS $\longrightarrow HO_2^- + OH^-$
THE PEROXIDE ION DECOMPOSES CHEMICALLY,
$HO_2^- \longrightarrow \frac{1}{2}O_2 + OH^-$
TO GIVE:
$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$

FIG. 3. Diagram of National Carbon fuel cell.

composed of either a porous, sintered semi-conducting nickel oxide or silver wire gauze. Either gives good results.

The fuel gas electrode is made of porous sintered nickel metal, although other materials, such as porous iron, can be used. Work is presently being conducted with pressurized double-porosity type electrodes, which are expected to give better performance.

National Carbon Company's fuel cell, a low temperature hydrogen-oxygen type, is being used to power the Army Signal Corp's "Silent Sentry"—a lightweight, portable radar set for local combat surveillance. National Carbon, a division of Union Carbide Corporation, developed the cell at its Parma, Ohio, research labs.

Theoretically, life of the cell is unlimited. The cell is described as a sealed jar into which are fed hydrogen and oxygen through special hollow electrodes made of porous carbon. Electrochemical reaction of the gases at the electrodes produces an electric current, with water as the only by-product. Thus the operating principle is simply water electrolysis in reverse. Photograph of an operating fuel cell of this type, displayed at the 1958 A.G.A. annual convention, is shown in Fig. 2, and a simplified working drawing is shown in Fig. 3.

Mechanism of the electrode reactions limits maximum conversion of fuel energy values into electrical energy to a value slightly over 80 percent. For fuel cells operating at practical current density values, conversion efficiency ranges from 65 to 70 percent.

Operating temperature range is 120 to 140 F, and operating pressure is approximately atmospheric. Increased output can be obtained by increasing the operating pressure.

National Carbon's design objectives call for a fuel cell operating on air at atmospheric pressure to produce one-fourth of a kilowatt per cubic foot and three watts per pound of cell weight. For fuel cells operating on pure oxygen and pressurized to five atmospheres (75 psig), design objectives are 1 to 1.5 KW per cu ft and three watts per pound of cell weight. A practical working fuel cell would use 12.5 standard cu ft of oxygen and 25 standard cu ft of hydrogen to produce one kilowatt hour of energy.

Allis-Chalmers Manufacturing Company has developed a hydrogen-oxygen fuel cell using metal electrodes coated with a catalyst. A laboratory model of the fuel cell — consisting of a small sheet metal box containing 24 separate cells, each with an output capacity of one volt — has been demonstrated. The unit produced enough electrical power to illuminate two 15-watt light bulbs.

In each individual cell, the two catalyst-coated electrodes are separated by an electrolytic solution. Power is produced by the electron-freeing chemical reaction that occurs when oxygen and hydrogen are fed into the electrodes.

Patterson-Moos Division of Universal Winding Corporation has license in the U. S. for the F. T. Bacon fuel cell, a low-temperature, high pressure hydrogen-oxygen unit developed in England. The Bacon cell is rated at 10 kilowatt hours per cubic foot at full load. Patterson-Moos is also developing cells that will use hydrocarbons such as ethane and methane as fuels.

Lockheed Aircraft Corporation's Missiles Systems Division is working on fuel cells that would operate on liquid and solid fuels and have efficiencies up to 70 percent. The division is currently working on a cell that would produce 100 watt-hours per pound of cell weight. Lockheed has also been successful in preventing electrode "poisoning," which results from common electrochemical energy conversions.

Other researchers include Esso Research and Engineering Corporation (Standard Oil Company of New Jersey), which is working on cells that would use hydrocarbons as fuels; General Motors, which has developed a cell that uses formaldehyde as a fuel; General Electric; Westinghouse and Chrysler Corporation. Numerous other companies are reported interested in fuel cells and some are doing research.

What the Fuel Cell Means

To the gas industry, development of efficient, and economical fuel cells, using natural or manufactured gas as a fuel and air as an oxidant, should open up an entire new era of energy production and utilization.

It would be possible — and probable — that fuel cells would eventually find their way into many industrial uses and conceivably could be used for residential purposes.

Commercial application of the fuel cell would have a major effect in extending the life of the nation's fossil fuel reserves. And because fuel cells using gaseous fuels seem to be the most promising, an intimate link between the gas industry and the fuel cell industry seems inevitable. Solid fuels are seen as creating many operating problems in fuel cell operation and they have inherently lower efficiencies. The fuel cell, therefore, could be a major factor not only in the overall energy system, but also in the future utilization of gas.

* * *

Hi-Btu Gases from Fluid Fuels

Present and Future Methods

Part 2 — Production of High-Btu Gas From Natural Gas Liquids and Petroleum Oils

Henry R. Linden, *Research Director, and* **Martin A. Elliott,** *Director, Institute of Gas Technology, Chicago, Illinois*

Process Fundamentals

Conventional method for producing high-Btu gas from liquid fossil fuels is high-temperature thermal cracking (pyrolysis) at average cracking temperatures of 1300 to 1700 F, reaction times of 1 to 10 seconds, and near-atmospheric pressure.

The influence of feedstock properties and operating conditions (reaction time, cracking temperature, pressure and dilution with inert or reactive carrier gases), or gaseous and nongaseous product yields and compositions has been studied extensively.

The rapid decrease of the weight percent gas yield, and the comparable increase in nongaseous products, with increases in feedstock C/H weight ratio is illustrated in Table 7 with data for feeds ranging from propane through Bunker "C" fuel oil. The weight percent gas yield is directly related to the recovery of the heat of combustion of the feedstock in the form of stable gas (Btu recovery), which determines to a large extent the value of a given feedstock.

Table 7 shows that, under nearly constant operating conditions, the nongaseous product distribution varies considerably with feedstock properties, whereas the gaseous product distribution shows only little variation. This is the result of the independence of the vaporphase reactions from feedstock properties after the primary cracking reactions (that is, those specific to the feed hydrocarbon) have been completed.

In high-temperature cracking at reaction times of more than one second, only the lowest molecular weight members of each homologous series of hydrocarbons (for example, methane and ethane in the paraffin series), give significant deviations from the normal product gas composition. The high molecular weight condensed-ring hydrocarbons, however, which are found in the high-boiling fractions of petroleum and shale oils, do not crack in the vapor phase; they form high molecular weight aromatics (tar and pitch) and coke directly by dehydrogenation, cyclization and polymerization.

As a result, the composition of the liquid cracking products, and the amount of coke formed, are highly dependent on feedstock properties other than C/H weight ratio, although the relative proportion of the gaseous and nongaseous products depends only on this parameter at equivalent cracking conditions.

The composition of both gaseous and nongaseous products is greatly affected by severity of cracking. Increases in either temperature or reaction time increase the severity of cracking, although reaction time has a lesser effect under conditions of high-Btu gas production. A good index of the severity of cracking is the true oil gas heating value (the heating value of hydrogen-gaseous hydrocarbon fraction of the cracking products), which decreases as the severity of cracking increases. At a given pressure and inert dilution, the true oil gas heating value defines the composition of the gaseous products obtained in different types of apparatus over a wide range of feedstock properties, cracking temperatures, and reaction times.

Effect of severity of cracking on the yields and composition of products obtained in the production of high-Btu gas from diesel oil, premium residual oil, and Bunker "C" fuel oil is shown in Table 8. As severity of cracking increases, increased volumes of gas containing substantially more hydrogen and less higher molecular weight hydrocarbons are produced. This is accompanied by increased coke and carbon formation, and formation of liquid products having a higher specific gravity and free carbon content. Under very severe cracking conditions, Btu recovery decreases *(see data for diesel oil, Table 8).* Incomplete cracking of the diesel oil at low severities of cracking is indicated by a high sulfonation index (high paraffin content) of the liquid products, and a somewhat lower Btu recovery.

Conversion of liquid feeds at normal storage temperature into thermal cracking products at 1400 to 1500 F requires approximately 1500 to 2000 Btu per lb which includes sensible heat, heat of vaporization, and endothermic heat of reaction (cracking).

The methods of supplying this heat, and the maintenance of continuity of operation under conditions leading to the formation of coke and pitch, are basic processing problems. Solution of these problems has led to alternate schemes for high-Btu gas production by simple thermal cracking:

1. The use of stationary heat storage, usually consisting of refractory shapes, which are alternately heated by combustion of deposited carbon and the required supplemental fuel, and cooled by contact with the process feed;
2. The use of circulating heat storage of either the fluid-bed or moving-pebble bed type. The solid burden is continuously reheated in one vessel or zone by carbon burnoff and combustion of the required amount of supplemental fuel, and continuously cooled in another vessel or zone by contact with the process feed.

A modification of thermal cracking for gasification of liquid fossil fuels involves cracking in an atmosphere rich in hydrogen (hydrogasification), preferably at superatmospheric pressure.

Such a processing scheme has the following advantages:

1. **Total gas formation** is increased by suppression of net hydrogen production from the hydrocarbon feed, even at atmospheric pressure, with attendant reduction of formation of nongaseous products, including carbon.
2. **Production of gaseous paraffins** is increased, and of gaseous olefins decreased, thereby increasing the substitutability of the product for natural gas. This effect can be obtained by the use of superatmospheric pressure alone; however, increase in gasification pressure without the use of feed hydrogen will reduce total gas yields, and increase nongaseous products formation.
3. **Nearly complete conversion** of any feedstock to a high-methane content gas can be achieved by proper adjustment of hydrogen/oil feed ratio, pressure, and reaction time in the usual cracking temperature range.
4. **Processes can be designed for continuous operation** with minimum by-product formation for the entire range of fluid fossil fuels.

TABLE 7. Pyrolysis Product Distribution for Laboratory Tube Operation with Various Feed Hydrocarbons At Approximately Constant Severity of Cracking

Run No.	248	251	239	352	233	446	277
FEEDSTOCK	PROPANE	BUTANE	12-lb RVP NATURAL GASOLINE	LIGHT DIESEL OIL	REDUCED CRUDE	CRUDE SHALE OIL	BUNKER "C" FUEL OIL
Carbon/Hydrogen Weight Ratio of Feedstock	4.5	4.8	5.2	6.39	7.25	7.48	8.51
Carrier Gas	None	None	None	Steam	N_2=CO_2	Steam	N_2
Total Pressure of Product Gas, atm	0.996	1.02	0.994	1.05	1.07	1.01	1.00
Partial Pressure, atm*	0.982	1.00	0.993	0.756	0. 924	0.690	0.750
Cracking Temperature, °F	1500	1500	1500	1570	1550	1550	1550
Reaction Time, sec	4.45	4.26	4.19	2.56	2.36	2.47	1.53
Gaseous Products Wt % of Feed†	80.2	73.4	63.2	54.2	47.7	44.7	34.7
Composition, mole %*							
Hydrogen	24.2	22.1	22.5	26.3	25.6	26.3	24.7
Methane	48.3	49.4	48.3	44.0	43.0	43.6	45 6
Ethane	2.6	2.7	2.8	2.4	2.7	2.6	3.1
Propane	0.2	0.3	0.3	—	—	—	—
Butanes	0.1	0.3	0.2	—	—	0.1	—
Pentanes	—	0.1	—	—	—	—	—
Ethylene	21.7	21.4	23.5	22.8	23.7	21.6	20.3
Propylene	1.0	0.9	0.8	1 1	2.0	1.6	3 2
Butylenes	0.1	0.1	0.1	0/2	—	—	0 5
Butadienes	0.7	0.5	0.6	0.7	0.7	1.0	0.9
Pentadienes	0.1	0.1	0.1	0.2	0.2	0.2	0.2
Benzene	0.6	0.7	0.7	1.8	2.0	2.3	1.3
Toluene	Trace	0.1	0.1	0.1	0.1	0.2	0.1
Acetylene	0.4	1.3	—	0.4	—	0.5	0.1
Liquid Products Wt % of Feed**	19.0	25.0	36.3	42.5	41.8	49.8	51.9
Distillation, wt %							
0-200°C	54.5	50.0	52.8	20.8	15.4	10.4	7.1
200-300°C	19.5	19.8	21.1	27.2	17.8	15.7	11.2
300-355°C	5.9	7.7	8.3	8.9	6.7	8.8	17.0
Residue by Difference	20.1	22.5	17.8	43.1	58.5	65.1	64.7
Solid Products, wt %	0.8	1.6	0.5	3.3	10.5	6.5	13.4

*H_2 — gaseous hydrocarbon fraction.
†Includes unstable higher hydrocarbon content of raw product gas and small amounts of N_2, CO, CO_2 and sulfur compounds produced from feed.
**Corrected to 100% material balance.

Two other modifications of high-temperature cracking processes, originally developed for cyclic low-Btu gas production, can be adapted for high-Btu gas: **Catalytic steam cracking** and **partial combustion.**

In catalytic steam cracking, the conversion of feedstock to gas is increased by the reaction of steam with hydrocarbons and deposited carbon to form carbon monoxide and hydrogen. The full potentiality of this process for giving high gas yields cannot be attained in high-Btu gas production because of the relatively low temperature that must be used in this type of operation.

In partial combustion processes, most of the total heat requirements are supplied directly by oxidizing a portion of the feedstock with air, oxygen or oxygen-enriched air. Feedstocks are generally limited to natural gas liquids when high-Btu gas is the desired product to avoid excessive carbon deposition and liquid products formation. When air is used as the oxidant, the attendant nitrogen dilution of the product gas requires considerable breakthrough of unreacted feed to obtain high heating values.

Cyclic Thermal Cracking Processes

Cyclic thermal cracking of distillate and residual oils in an atmosphere of steam at near-atmospheric pressures is the only process now used commercially to produce high-Btu gas from these feedstocks.

This situation exists because manufactured gas companies that changed over to natural gas distribution already had available carbureted water gas sets that could be converted at moderate cost to sets capable of producing 1000 Btu/Scf gas from petroleum feedstocks. This conversion resulted in a substantial increase in the thermal capacity of the set, and in considerable simplification in operation through ultimate elimination of solid-fuel handling.

The history of the development of various high-Btu oil gas processes has been reviewed by Morgan. In some of the early development solid fuel was used. Subsequently, the use of solid fuel was discontinued for economic reasons and grates were either removed or covered with a refractory screen.

Cyclic thermal cracking processes for converting distillate and residual petroleum oils into high-Btu gas, light aromatics, tar and deposited carbon are conducted in refractory-lined or filled vessels.

Deposited carbon is burned off by periodic air blasting, supplying part of the process heat requirements. The remainder of the heat to maintain the desired cracking temperature (1400 to 1700 F) is supplied by the combustion of heat oil during the blast period.

This period is followed by a steam purge, a make period (during which process oil is introduced into the heated cracking zone), and, finally, a second steam purge and a blast purge.

If regenerative heating of the blast air and steam is used, the thermal efficiency of the process may be as high as 85 percent (including the heat of combustion of liquid by-products).

Liquid by-products constitute up to 50 weight percent of the feed oil. Recovery of these products requires considerable investment in plant and labor. Consequently, in peak load operation, net by-product credits are reduced not only because of this, but also because the irregular production adversely affects marketability.

High-Btu oil gases produced in cyclic processes contain substantial quantities of nitrogen and carbon dioxide formed during the blast purge part of the cycle. Furthermore, depending on condensing conditions, the aromatic content of raw oil gas can be as high as 5 volume percent.

As a result, combustion characteristics of such high-Btu oil gases differ radically from those of natural gas, which normally has a much lower specific gravity and consists primarily of the slow burning paraffins, methane and ethane.

Oil gases tend to flash back because of their higher burning velocities, and to produce luminous flames because of their high content of unsaturated hydrocarbons. Scrubbing with absorption oil to remove low molecular weight aromatics (light oil) reduces yellow-tipping.

In general, high-Btu oil gases produced in conventional cyclic thermal cracking processes are not substituted for natural gas in concentrations above 50 volume percent.

TABLE 8. Laboratory Tube Furnace Test Results for the Production of High-Btu Oil Gases at Atmospheric Pressure with Approximately 10 to 30 Volume Percent Steam or Inert Carrier Gas Dilution

Run No.	371	291	286	352	221	328	339	257	234	270	277	241
Oil												
Type	Diesel Oil				Premium Residual Oils*				Bunker "C" Fuel Oil (Texas Crude)			
°API	37.3				21.4			19.8	9.9			
Carbon/Hydrogen Weight Ratio	6.39				7.04			7.25	8.51			
Conradson Carbon Residue, wt %	0.004				4.42			5.66	10.73			
Reaction Time, sec	1.20	5.15	1.58	2.56	2.47	2.51	2.40	4.30	1.85	4.03	1.53	2.05
Cracking Temp, °F	1400	1400	1550	1570	1400	1470	1550	1550	1400	1400	1550	1550
Btu Recovery, MBtu/gal	87.6	90.8	86.8	81.5	86.7	85.7	81.8	79.8	62.8	62.7	64.3	64.6
True Oil Gas Yield, SCF/gal	61.5	72.8	73.5	79.4	62.4	69.9	79.1	81.4	46.7	50.8	57.2	61.1
Liquid Products Yield, wt %†	39.5	37.7	38.6	42.5	38.7	38.3	39.6	41.2	55.0	53.1	51.9	48.6
Carbon Deposition, wt %	0.4	1.3	2.9	3.3	5.1	7.4	11.2	11.8	9.0	12.5	13.1	16.1
True Oil Gas Properties												
Composition, mole %												
Hydrogen	13.8	17.8	20.4	26.3	15.5	16.5	27.7	30.8	15.9	16.4	24.7	28.5
Methane	33.4	42.5	43.6	44.0	37.8	40.0	42.6	46.1	42.2	45.2	45.6	43.6
Ethane	4.9	4.7	3.1	2.4	6.1	5.1	2.4	1.7	6.3	5.5	3.1	2.8
Propane	0.4	0.9	0.1	—	1.2	0.2	0.1	0.3	0.5	—	—	1.0
Iso-Butane	0.1	—	—	—	—	—	—	—	—	0.1	—	—
N-Butane	—	—	—	—	0.2	0.1	—	—	0.1	—	—	0.1
Pentane	—	—	—	—	0.1	—	—	—	—	—	—	0.1
Ethylene	29.5	25.6	26.2	22.8	24.6	27.1	23.1	17.5	21.9	21.6	20.3	19.2
Propylene	11.1	3.8	2.9	1.1	8.6	5.9	1.5	0.7	8.1	6.2	3.2	2.2
Butylenes	2.1	0.6	0.3	0.2	1.4	0.8	0.1	—	1.5	1.1	0.5	0.4
Butadienes	2.5	1.2	1.0	0.7	1.8	1.9	0.6	0.3	1.5	1.4	0.9	0.4
Pentenes	0.4	—	—	—	0.1	—	—	—	0.1	—	—	—
Cyclopentadiene	0.6	0.3	0.2	0.2	0.8	0.4	0.1	0.1	0.6	0.1	0.2	0.3
Acetylene	0.3	0.4	0.5	0.4	—	0.3	0.4	0.4	—	—	0.1	—
Benzene	0.8	1.9	1.4	1.8	1.5	1.6	1.4	2.0	1.2	2.1	1.3	1.3
Toluene	0.1	0.3	0.3	0.1	0.3	0.1	—	0.1	0.1	0.3	0.1	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Heating Value, Btu/SCF**	1425	1247	1182	1025	1388	1225	1034	981	1346	1234	1124	1008
Specific Gravity, Air=1**	0.843	0.706	0.695	0.600	0.857	0.764	0.610	0.549	0.749	0.678	0.612	0.581
Liquid Products Properties												
Specific Gravity, 60°F/60°F	0.970	1.070	1.075	1.088	1.086	1.096	1.161	1.184	1.117	1.106	1.157	1.147
Free Carbon, wt%	0.3	3.6	6.7	7.6	6.9	8.5	18.7	28.7	11.0	10.3	18.8	22.9
Sulfonation Index, ml unsulfonated residue/100 gm tar												
For distillate 0-300°C	10.9	1.9	6.4	4.8	0.7	1.7	1.4	0.0	0.0	0.5	0.7	0.0
For distillate 300-355°C	0.9	0.6	2.4	0.7	0.6	0.2	0.3	0.0	2.3	0.7	0.7	0.5

*Runs 221, 328 and 339 — reduced crude oil; Run 257 — New England gas enrichment oil.
†Corrected to 100% material balance based on volume and specific gravity of total raw product gas, including small amounts of N_2, CO, CO_2 and sulfur compounds produced from oil; true oil gas yields and properties based on hydrogen-hydrocarbon fraction of stabilized gas.
**Experimental value corrected to inert-free basis.

The major types of converted high-Btu oil gas sets now in use are:

1. The **single-generator set** consisting of two shells — the oil gas generator and the superheater;

2. The **single, bottom burner-fired set** consisting of three shells — the combustion chamber, the oil gas generator, and the superheater;

3. The **twin-generator set** consisting of three shells — the two oil gas generators and a superheater,
   a. without backblast, and
   b. with backblast;

4. The **three-shell regenerative set** consisting of a regenerator, and a superheater; and

5. The **Hall regenerative set,** consisting of four shells — two generators and two superheaters.

Schematic diagrams of representative examples of these various types of set conversion are shown in Fig. 3. Costs of converting existing carbureted water gas sets to most of the types listed above have been estimated by Henry, and estimates of complete carbureted water gas plant conversion costs have been reported by Carroll.

Single and twin-generator units are primarily suited for operation with distillate oils. Twin-generator units, although requiring a more costly conversion, have substantially greater gas-making capacity and can be adapted to residual oil operation by addition of generator stacks and a backblast (Fig. 3) to remove carbon deposited in the generators.

Operation on Bunker "C" oil, however, is not entirely satisfactory, and thermal efficiencies are relatively low because sensible heat is lost through the generator stacks, thereby increasing the heat oil requirements.

The three-shell regenerative set design also appears to have limited flexibility in regard to feedstock quality.

In contrast, the Hall high-Btu oil gas process, which is completely regenerative, has operated well at high thermal efficiencies on residual oils with 13 percent Conradson carbon residue, and has gained widest acceptance for winter base load operation with low-cost oils. Both new and converted units of the original four-shell design, as well as newly constructed units of two-shell design (Fig. 4), were put into service in many locations and have been used to provide significant quantities of base load, winter base load, or peak shaving gas.

Successful high-Btu oil gas operation with low-grade residual oils was also achieved in partially regenerative, up-

TABLE 9. Investment Costs for New High-Btu Oil Gas Plants and Plant Additions

(Basis: Land, compressor station and storage holder not included)

1955 Estimate

Size of Plant MCF/Day	Number of Operating Units	Approx. Erected Plant Cost, $/MCF Daily Capacity*
5,000	Two 12-ft O.D. units (one for spare)	262
10,000	Three 12-ft O.D. units (one for spare)	202
15,000	Three 13-ft O. D.units (one for spare)	182
20,000	Four 13-ft O.D. units (one for spare)	170

*Includes relief holder, buildings, operating units, all tar and light oil recovery and handling equipment, purifiers, exhausters and piping; premium residual oil operation.

1956 Estimate (Light Oil Stripping Plant Not Included)

Size of Plant MCF/Day	Type of Plant	Average Investment Cost Light Oil Operation	$/MCF Daily Capacity Bunker "C" Oil Operation
7,000	Addition*	164†	193†
20,000	Addition	200	280
	New	275	365
40,000	Addition*	175	225
	New	220	270
100,000	New	170	208

*Assumes that general buildings, roads, dock and railroad siding are available and that steam, water and electrical systems require additions.
†Assumes that relief holder, cooling water, light oil scrubbers, meters and purifiers are also available.

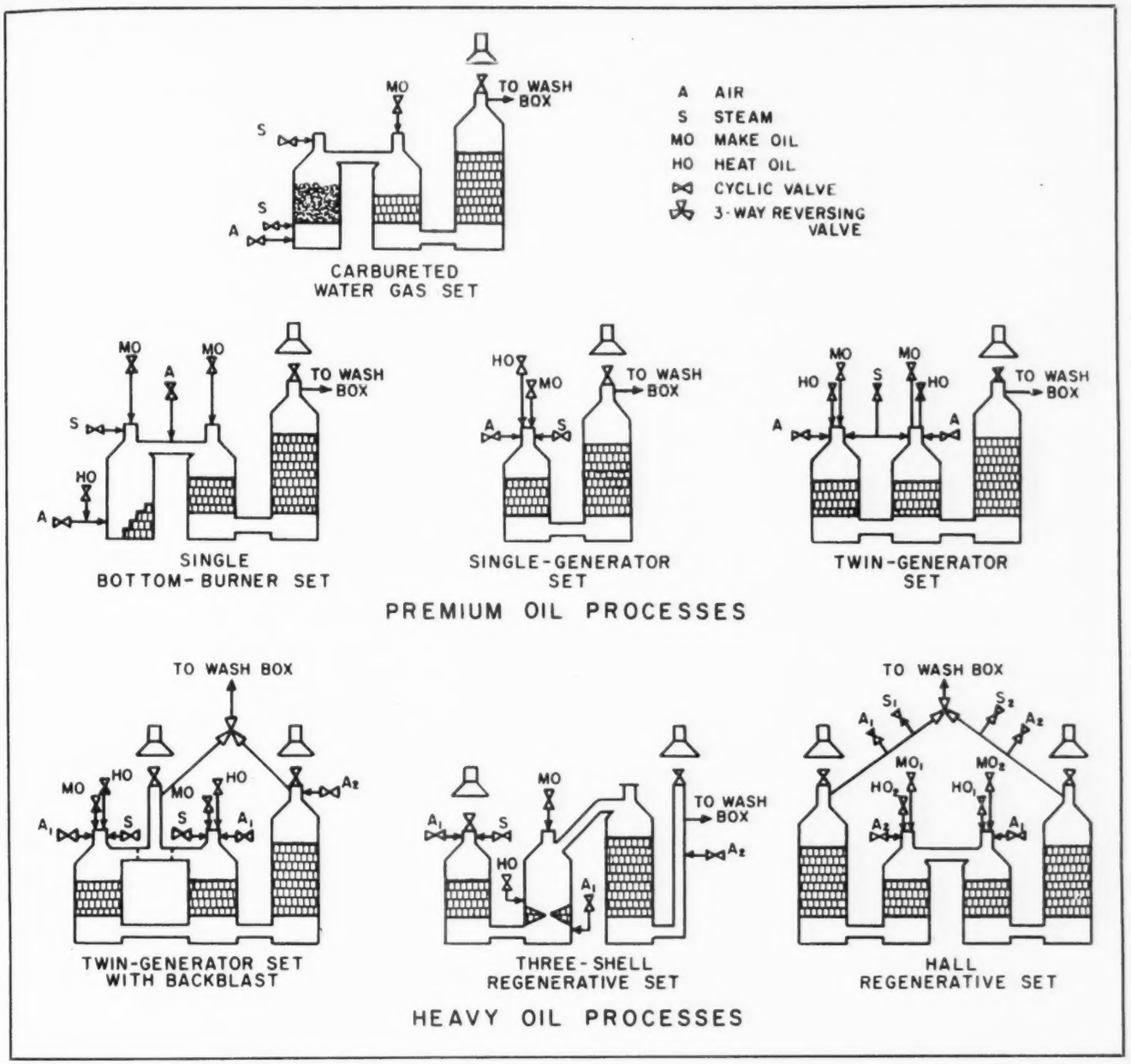


FIG. 3. Basic carbureted water gas set is shown at top. Typical conversions to high-Btu oil gas operation are shown in other drawings.

right "U," twin-shell Pacific Coast oil gas sets originally designed for low-Btu oil gas production and by-product lampblack recovery.

Estimates of investment costs for new Hall sets and plants were published by Henry in 1952. Table 9 summarizes revised estimates of high-Btu oil gas plant investment costs reported by Henry in 1955 on the basis of data supplied by a major builder, and average 1956 investment costs for additions to high-Btu oil gas plants and for new high-Btu oil gas plants, as reported by Carroll in 1957 on the basis of widely differing estimates supplied by three builders.

Henry's value for a 20 MMcf per day plant, and Carroll's for a 20 MMcf per day plant addition (Table 9), agree reasonably well with comparable estimates for the erected cost of four Hall sets and auxiliaries (including piping, wiring, foundations, housing, relief holder, exhausters and complete by-product recovery and handling equipment) of $255 per Mcf daily capacity for Bunker "C" operation, and $161 per Mcf daily capacity for premium oil operation, reported by Chaney in 1956.

These values are based on a total plant cost of $5,615,000,

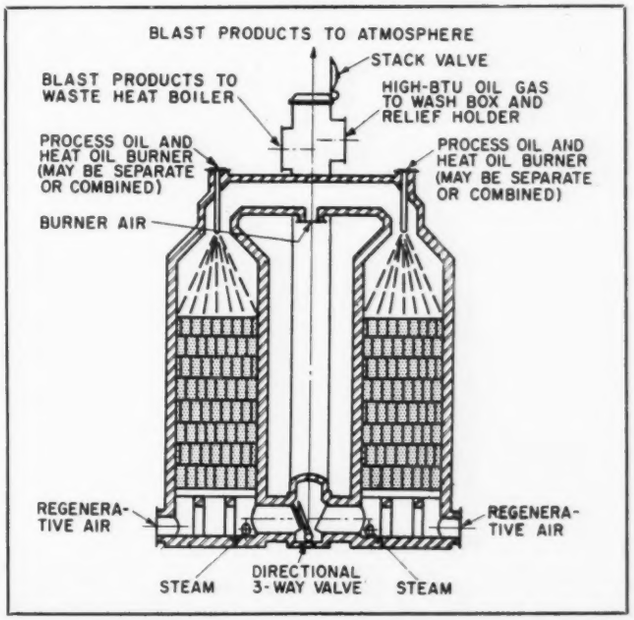

BLAST PRODUCTS TO ATMOSPHERE
STACK VALVE
BLAST PRODUCTS TO WASTE HEAT BOILER
HIGH-BTU OIL GAS TO WASH BOX AND RELIEF HOLDER
PROCESS OIL AND HEAT OIL BURNER (MAY BE SEPARATE OR COMBINED)
PROCESS OIL AND HEAT OIL BURNER (MAY BE SEPARATE OR COMBINED)
BURNER AIR
REGENERATIVE AIR
REGENERATIVE AIR
STEAM
DIRECTIONAL 3-WAY VALVE
STEAM

FIG. 4. Hall high-Btu oil gas process two-shell set.

and capacities of 22 MMcf per day with Bunker "C" oil and 34.8 MMcf per day with premium oil.

Many economic analyses of high-Btu oil gas processes have been published. Reported gas costs differ widely, however, not only because of differences in plant equipment, method of computing fixed charges, and rapidly changing costs during the period in which the estimates were made, but also because of substantial differences in the basic process requirements and by-product yields. The latter are due to differences in oil properties and operating conditions, and in accuracy of some of the plant measurements.

Accordingly, it appears desirable to present a consistent group of estimates to show gas production cost for a variety of make oils:

C/H Weight Ratio	Btu Recovery MBtu per lb of Make Oil	Liquid Products Plus Carbon, Weight % of Make Oil
5.0	16.7	26
5.5	15.3	32
6.0	13.9	37
6.5	12.5	42
7.0	11.1	47
7.5	9.8	52
8.0	8.7	58
8.5	7.7	63
9.0	6.8	68
9.5	6.1	73

Suitable process data for such estimates are shown in the table above; these data were derived from correlations between oil properties and gasification results that agree closely with plant data, after allowance for differences in the removal of light oil from the raw product gas.

Btu recoveries on a weight basis can be used directly to estimate relative set capacities as a function of oil properties where heat storage capacity is the limiting factor, on the assumption that the heat requirements for cracking a unit weight of oil do not vary significantly with C/H weight ratio. Since liquid fuels are generally purchased on a volume basis, the Btu recovery per gallon is more useful in estimating the gas-making value of a feedstock. It is important to note that an increase in C/H weight ratio will not necessarily give the same uniform decrease in Btu recovery per gallon of oil as shown above for Btu recovery per pound of oil, since increases in C/H ratio can be partially or completely offset by increases in specific gravity (decreases in API gravity).

A good approximation for coke or carbon deposition is given by the expression:

Wt % deposited carbon =
weight % Conradson carbon residue, plus a constant.

The value of the constant is usually taken as 3 weight percent, but must be increased when the true oil gas heating value falls below 1200 Btu/Scf, to account for greater carbon formation and retention of pitch in the set. With the computed value for deposited carbon, the yield of liquid products can be estimated from the total nongaseous product yields given above.

TABLE 10. Typical High-Btu Oil Gas Production Costs, Including Light Oil Recovery, in 21 MMCF/Day Capacity Hall Process Plants Installed in Existing Manufactured Gas Production Plants

Oil						
Type	Premium Distillate Oil		Reduced Crude Oil*		Bunker "C" Fuel Oil	
°API	37		20		12	
Specific Weight, lb/gal	6.99		7.78		8.21	
Carbon/Hydrogen Weight Ratio	6.4		7.1		8.0	
Conradson Carbon Residue, wt%	0		6		12	
Heating Value, Btu/gal†	138,000		149,000		153,000	
Process Requirements						
Make Oil, gal/MCF	11.2		11.9		14.0	
Heat Oil, gal/MCF	1.4		1.0		0.45	
Total Steam, lb/MCF	140		140		160	
Power, kwh/MCF	2		2		3	
Liquid Byproducts, gal/MCF	3.3		3.9		5.2	
Unit Prices or Credits						
Oil, cents/gal	11		8 (6.6)		7	
Steam, cents/1000 lb (Bunker "C" fuel cost only)	70		70		70	
Power, cents/kwh	1		1		1	
Liquid Products, cents/gal	10		10		10	
Material, Utility and Miscellaneous Supply Costs,$/MCF						
Make and Heat Oil	1.39		1.03 (0.85)		1.01	
Steam	0.10		0.10		0.11	
Power	0.02		0.02		0.03	
Purification and Miscellaneous Supplies	0.03		0.04		0.05	
Total	1.54		1.19 (1.01)		1.20	
Byproduct Credits, $/MCF	0.33		0.39		0.52	
Net Material, Utility and Miscellaneous Supply Costs, $/MCF	1.21		0.80 (0.62)		0.68	
PLANT EQUIPMENT AND COSTS**						
Number and Type of Sets	3-12 ft O.D. Inverted "U" Sets		4-13 ft O.D. Inverted "U" Sets (one spare)		5-13 ft O.D. Inverted "U" Sets (one spare)	
Set Capacity, MCF/day	7000		7000		5250	
Cost of Single Set and Blower, thousands of dollars	500		550		550	
Cost of General Plant and Byproduct Recovery Facilities (excluding site, site improvements, steam plant, general plant buildings, oil and finished byproduct storage, purification equipment, storage holder, compressor station) thousands of dollars	3200		3300		3400	
Total Plant Cost, thousands of dollars††	4700		5500		6150	
Total Investment Cost, $/MCF daily capacity††	220		260		290	
Annual Fixed Costs						
Capital Charges (depreciation, taxes, insurance and return) 15% of investment/MCF daily capacity	33.0		39.0		43.5	
Labor, Supervision, Maintenance and Testing Materials and Working Capital, 4% of investment/MCF daily capacity***	8.8		10.4		11.6	
Total Annual Fixed Costs, $/MCF daily capacity	41.8		49.4		55.1	
Annual Production, % of nominal capacity	5	25	5	25	5	25
Unit Fixed Costs, $/MCF	2.29	0.46	2.71	0.54	3.02	0.60
Total Gas Cost, $/MCF	3.50	1.67	3.51 (3.33)	1.34 (1.16)	3.70	1.28

*Values in parenthesis based on $2.75/barrel cost of imported crude of equivalent gasification characteristics.
†Estimated from correlation given in IGT Research Bulletin 9.
**Estimated from data given by Carroll, Henry, and Chaney.
††Note specific items excluded from total plant cost; for cost of complete plants see Table 9.
***Estimated from data given by Carroll; labor force assumed constant for entire year.

Heat oil requirements depend on the quantity of carbon deposited, the efficiency of utilization of deposited carbon, and the efficiency of heat recovery from effluent process streams. Fully regenerative sets require substantially less heat oil than partially or nonregenerative sets. Heat oil requirements also decrease with increase in the size of the set.

The heat oil required may be estimated by assuming an average heat requirement of 1800 Btu per lb of make oil, a thermal efficiency of 60 percent utilizing heat oil, and a heat combustion of deposited coke of 16,000 Btu per lb.

$$\text{Heat oil requirement, MBtu/MMBtu of make gas} = \frac{3000 - (160)\ (\text{weight \% deposited coke})}{\text{Btu recovery, MBtu per lb of make oil}}$$

On the basis of this expression, at a total carbon deposition of approximately 19 weight percent **(a Conradson carbon residue of approximately 16 weight percent),** no heat oil would be required in typical high-Btu operation.

Estimated cost of high-Btu oil gas produced from typical oils is shown in Table 10. Comparable process data were obtained as outlined above. Oil and liquid by-product prices are typical of 1957 Eastern Seaboard values. Capital costs were derived from data published by Chaney and Carroll. Effects of oil type, set design, and set size on set capacity were derived from data published by Henry and Chaney.

Table 10 shows that, for the conditions selected, a premium distillate fuel oil gives the lowest cost peak load (up to 5 percent load factor) gas, whereas a good grade of Bunker "C" fuel oil (C/H ratio not exceeding 8.0) gives the lowest cost winter base load (25 percent load factor) gas.

For peak shaving at load factors intermediate between these two, reduced crude oil priced at 40 cents per barrel above Bunker "C" fuel oil is least costly.

The results shown in Table 10 are sensitive to changes in oil costs and by-product credits, and also depend on the accounting procedures employed. For example, a $2.75 per barrel South American whole crude, with similar gas-making properties as the reduced crude, would be the preferred feedstock for the entire range of conditions assumed in Table 10.

In spite of such uncertainties, it is apparent that high-Btu oil gas production for peak shaving has a sound economic basis in areas served by long-distance transmission lines where manufactured gas plant facilities and low-cost oil are available, and where underground storage facilities are not available in the immediate vicinity.

Part 3 will appear next month.

Great Britain Awaits First LNG Shipment

Pat Loar, *Assistant Editor*

A HISTORY-MAKING SHIPMENT OF 32,000 BBL LIQUEFIED METHANE to be delivered in Great Britain sometime in February, may herald a new technique of gas supply. The *Methane Pioneer,* a 5000-ton dry cargo vessel specially converted to transport the ultra-cold liquid gas, left the Gulf Coast port of Lake Charles, Louisiana, in late January with its unusual cargo.

The venture is a joint effort of Constock International Methane, Ltd. and the Gas Council of Great Britain, participants in British Methane, Ltd., a Bahamian corporation that owns and operates *Methane Pioneer.* Constock is owned jointly by Union Stock Yard and Transit Company of Chicago and Continental Oil Company of Houston.

Success of the venture is certain to revive interest in the use of LNG (liquefied natural gas, of which methane is the principal constituent) for both base load and peak shaving purposes in the U. S., as well as serving as a new source of supply for the fuel-hungry European market.

Conceivably, huge volumes of gas presently being flared in Venezuela and the Middle East could be liquefied and transported by tanker to Europe at a fraction of the cost of manufactured gas now used in that area.

What's happening:

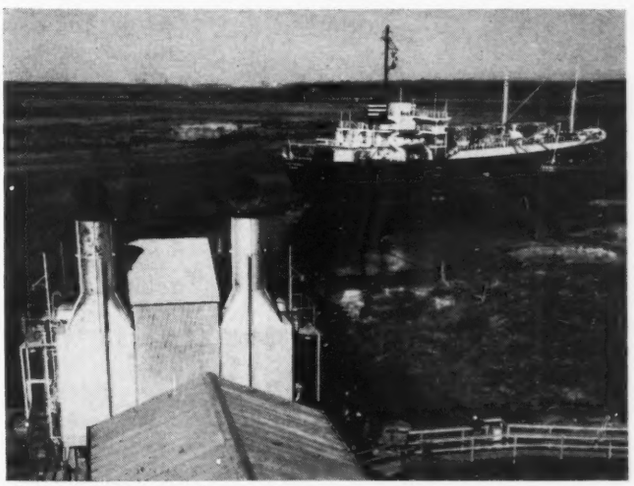
. . . **liquefaction** is accomplished by an existing barge-mounted liquefaction plant with a daily capacity of 6 to 8 MMcf per day of natural gas (approximately 1500 bbl). Liquefied methane output of the plant is stored onshore in the largest tank of its type ever built, a 67 ft diameter by 56 ft high cyrogenic storage vessel of flat-bottom, insulated double wall design, which stores LNG at –260 F. Tank capacity is 35,000 bbl.

. . . **the** *Methane Pioneer,* unlike conventional vessels for transporting LPG (that carry propane or butane under pressure in heavy metal cylinders) will carry the liquid methane at extremely low temperature (–258 F) and atmospheric pressure. Five specially designed aluminum tanks, lined with 12 in. of balsa wood for insulation, and enclosed in steel jackets, hold the liquid. The balsa wood liner is in direct contact with the liquid. As the methane seeps through the wood fibers, it forms minute gas bubbles to provide an excellent barrier to heat transfer. A small amount of gas vaporizes despite this insulation (about ½ of 1% daily) and is vented to atmosphere through vents high above the desk. Until Constock developed this method, trans-oceanic LNG transportation — not possible without pressure — was not considered feasible.

. . . **at the destination,** Canvey Island, two storage tanks, each of 15,000 bbl capacity, will receive and store the LNG, which is pumped to shore through heavily-insulated 6-in. line.

Vaporization will be by heat exchange with steam, and the gaseous methane will be piped to North Thames Gas Board's plant at Romford, on London's outskirts, where it will be mixed with refinery gases from Shellhaven refinery to form a 500 Btu gas suitable for distribution to consumers.

The experiment may open the way to bulk LNG importation to produce fuel cheaper than possible with current gas production methods used in Great Britain. Preliminary cost of LNG delivered at Romford is estimated at 50 cents per Mcf, compared to $1.61 per Mcf for manufactured gas at the same point. At 50 to 60 cents per Mcf, LNG should prove very competitive with manufactured gas costing $1 and up per Mcf throughout England and Europe.



Methane Pioneer, first ocean-going vessel designed to transport liquefied methane, is viewed from atop the barged-mounted liquefaction plant on Calcasieu River in south Louisiana, prior to its maiden voyage.

Employee Grievances

Here's a simple formula to help you handle this problem

Jack Bedford
Professor of Management, Armstrong College, Berkeley, California

MANAGEMENT OF A GAS COMPANY WOULD BE A GREAT DEAL EASIER if there were not employee grievances. On the other hand, such a situation might make the management job just a little boring. Every time an employee has some complaint or grievance — either voiced or concealed — there is a human relations problem that management must solve satisfactorily.

Even with detailed procedure for handling grievances, there are still a thousand little things that can and do happen to bring about minor grievances. These seemingly "petty" complaints and employee grievances can fester into serious sore spots and cause trouble in the harmonious operation of the business.

Here is a method of handling employee grievances that takes a lot of the **grief** out of **grievances.** It is easy to follow, easy to remember, and easy to apply. Here are the three simple steps of this formula for handling employee grievances:

1. **Cry**
2. **Listen**
3. **Smile**

Cry

When an employee has a grievance, it is a very real problem for him. Regardless of how trivial it may seem to anyone else, he is most sincere about his grievance. It is his complaint and he wants action — immediate and personal action.

One way to get the employee's viewpoint is to sympathize with him . . . cry over his problem. This makes the employee feel that he has at last found a friend.

Lack of friendship, according to industrial psychologists, is one of the major hidden reasons for an employee's grievance.

Employees with a grievance are not too sure of themselves. They tend, literally, to have a "chip on their shoulder" and may assume an antagonistic attitude at the slightest provocation. Approaching the employee with a sympathetic ear will ease the tension. Then, too, an employee who has found a friendly ear will talk more freely. As the employee talks to a friend he will get down to the true cause of his grievance. This makes it easy to follow the second step of the grievance handling formula . . . **listen.**

Listen

During the discussion with the employee, it is possible to arrive at the "real" cause of complaint, determine a solution for the employee's problem, and develop a plan for presenting the solution. All that is required to handle this step is to listen . . *listen attentively.*

As the employee talks, he will elaborate on each point. This will give good clues to the "real" cause of his grievance. With all of the facts of the case out in the open, it may be possible to avoid repetition of the same grievance.

For instance, the employee may be upset about his supervisor. He wants a change to some other work. When top management listens to the employee's complete story, it is possible to determine the true cause — *why the employee doesn't get along with his supervisor* — out into the open for discussion.

This makes it possible to correct the cause — *the foreman's attitude* — and avoid future similar problems.

Attentive listening encourages the employee to talk more freely. When the worker does not go into detail, the listener can encourage him to give more facts. One way is to look at the employee registering the grievance with a questioning glance that silently says, "Yes, go on . . . "

When the question pause does not get the worker to talk freely about his grievance, ask the employee, "yes, and . . . "

Smile

This is the crucial point in handling an employee's grievance. The employee feels that at last he has found a real friend. He has talked out his problem with someone who has been listening. He is ready for some action.

By smiling, the listener makes the employee feel he has a *sympathetic* friend. He is ready to accept the decision. If the smile is sincere, the employee will be more willing to go along with the final verdict about the grievance.

Smiles are good strategy. Smiles are dangerous, too. A smile that is laughing up the sleeve at the employee will do more harm than good. A smile that looks like a pasted on grin will cause the employee to change his attitude about the grievance handling and be more demanding.

Smiling is easy, however, if the first two steps of this formula for handling employee grievances have been done in a friendly, sincere manner. It will be a reflection of the attitude of the representative of management and will leave the employee with a pleasant feeling toward the executive level of the gas company. ★ ★ ★

Good Records Vital to Corrosion Control Program

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CORROSION CONTROL PROCEDURES are an important part of the operations of Kansas-Nebraska Natural Gas Company, Inc., yet they are not considered special projects; rather, they are as much a part of any job as is welding or pipe fitting. With the active endorsement of management and with full and active cooperation from supervision in each company department, a corrosion control program that has proved very effective has been in use for over 15 years in the company's distribution operations.

This article discusses the generalized policy procedure and some of the useful data recording that is relative to corrosion control in 169 retail towns served by Kansas-Nebraska Natural Gas Company. Of these 169 towns, 115 are all coated and wrapped systems and under full cathodic protection. The remaining 54 towns are spot protected or protected by sections — generally new additions or replacements.

The company's corrosion department is a separate unit and has corrosion problems as its major concern. It consists of five technicians and a small installation and maintenance crew. Division and district personnel assist in the corrosion control program through generalized policy procedure. New work is set up for corrosion control during engineering design and construction periods in all phases of company activity.

Occasionally, the department conducts corrosion control training schools for various groups of company personnel. These schools stimulate a better understanding and interest for our general corrosion control program. Roundtable discussions not only bring about a better integration of corrosion control procedures with other company activities, but frequently introduce the use of new improvements.

Work Procedure

Since 1944, all new construction or replacement has been made by using all welded steel pipe, coated and wrapped, and cathodically protected at the time of construction. Original towns, and those acquired, had systems consisting

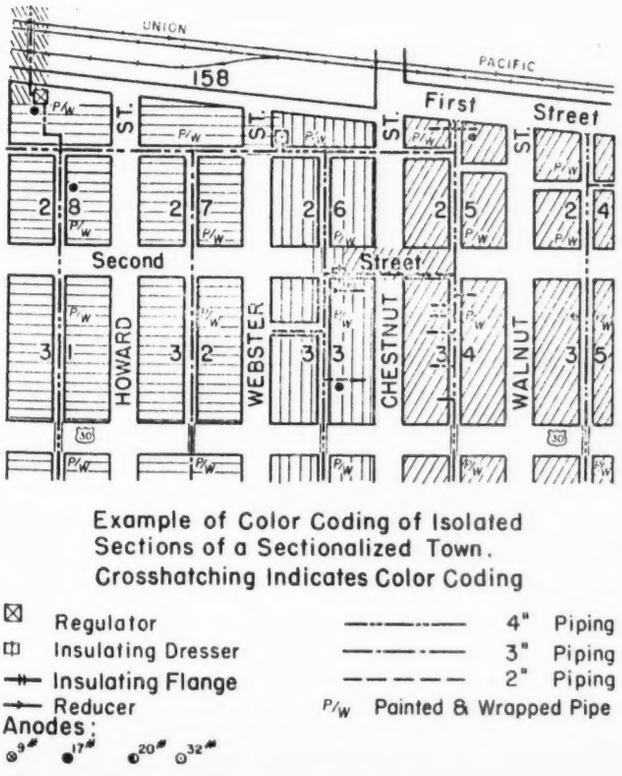


FIG. 1. Example of map and legend of symbols.

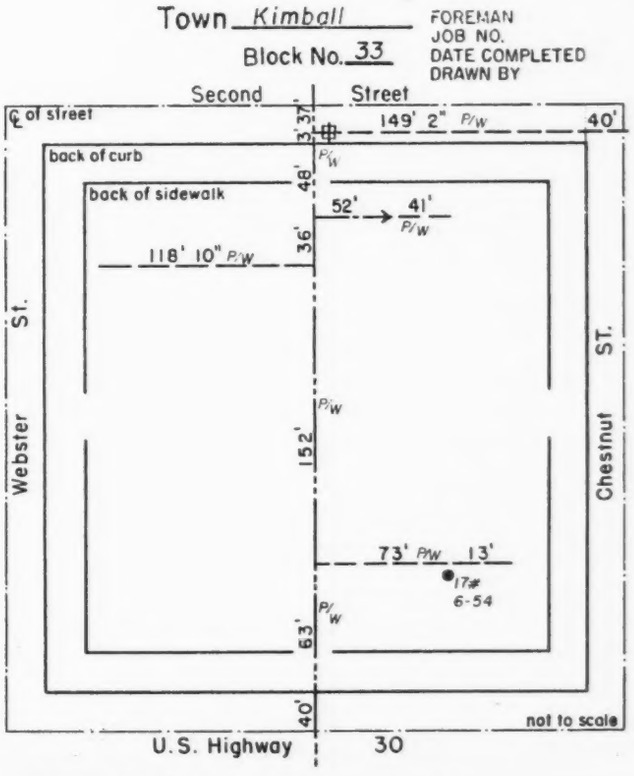


FIG. 2. Application of data to block card record.

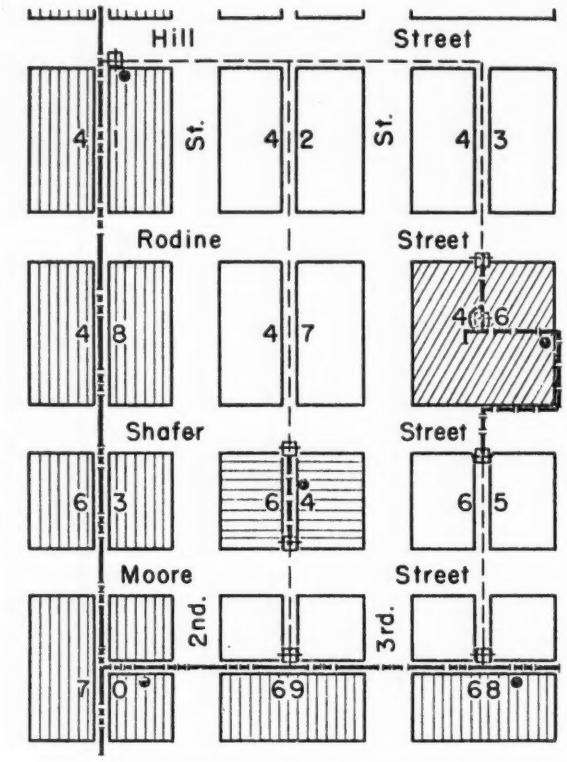


FIG. 3. Example of how maps used to indicate coated-and-wrapped pipe replacements and extensions in "bare" system towns.

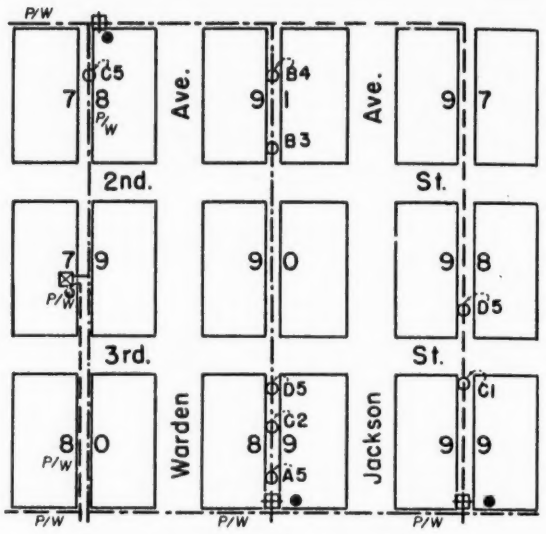


FIG. 4. Leakage survey map.

of bare welded or dresser-coupled steel pipe with every imaginable array of tap saddles, pipe fittings, etc., to make treatment difficult or less economically feasible. Until a generalized policy procedure was set up, any type of service stub, service line, building entry, or meter installation could be expected, depending principally on local habit.

Present procedure requires that a building entry be above ground level, with an insulating joint installed just outside the building. All service lines from the building to the property line are the customer's property and must be coated and wrapped. The meter is usually set at the property line and is insulated from the main if the mains are not cathodically protected. If the mains are cathodically protected, the meter setting is made conductive and the service line is included in the protection scheme at no cost to the customer.

A meter setting at the property line provides low-pressure gas to the customer's house instead of intermediate pressure, makes meter reading more convenient, reduces unaccounted-for leakage, is a leverage for immediate service-line replacement if leaking, and gives free access to the meters in times of emergency. It also helps in distributing anodes with above-ground-lead attachment, and provides free access to lead wires for testing.

In all of the older, all bare towns, service lines were insulated at the building entry and at the property line. If a section of "bare" town was to be protected, a service-line insulating project was set up and carried out. If no sectional protection was projected, the service-line insulating procedure was then made at the time the customer was shut-in for servicing or for meter change-out for test. At any time a customer is serviced, a complete premise survey is made for faulty appliances, faulty flues, leakage, etc.

New pipe replacements or extensions are all welded steel, coated and wrapped, and isolated from all bare structures, and cathodically protected by magnesium anodes at the time of construction by the crew doing the new work. All new towns or additions to towns are isolated by insulating joints into sections of no more than 12,000 ft of pipe. By so doing, trouble in one part of town will not affect the entire town and this allows easier location of the trouble. It is also possible to selectively treat an isolated section as requirements may dictate.

Monthly Cathodic Report

Broken Bow, Nebraska — Month Sept.

Annual Check, June 12, 1957

Business District

Location		Main	Service	P.D.	Present P.D.
Block 177	Brown McDonalds	1.37	.51	830	840
Block 107	Burlington Hotel	1.39	.53	850	820
Block 139	Nelson-Maple Mo.	1.39	.53	870	850
	West Side				
Block 163	Smith	1.20	.39	790	810
Block 158	Linder	1.20	.42	790	800
Block 135	Luther	1.20	.58	660	660
	Northwest				
Block 106	Snider	1.15	.33	820	820
Block 62	Bob Duryea	1.19	.42	760	750
Block 13	Bob Reed	1.19	.33	860	890
	North Side				
Block 18	Chrpin	1.22	.24	970	970
Block 64	Perney	1.18	.40	800	840
Block 101	John Luethje	1.23	.54	690	850

FIG. 5. Example of monthly cathodic report.

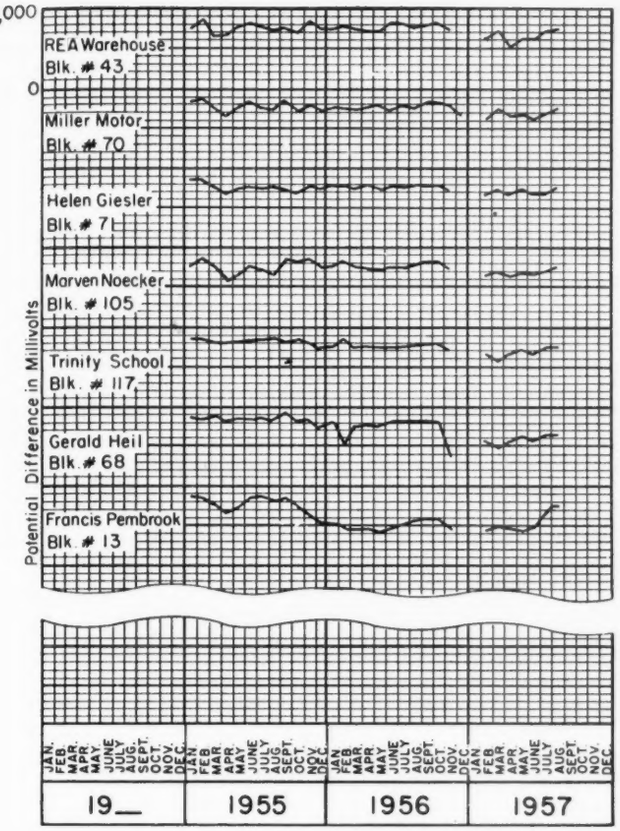


FIG. 6. Example of typical monthly check report, Hartington, Nebraska.

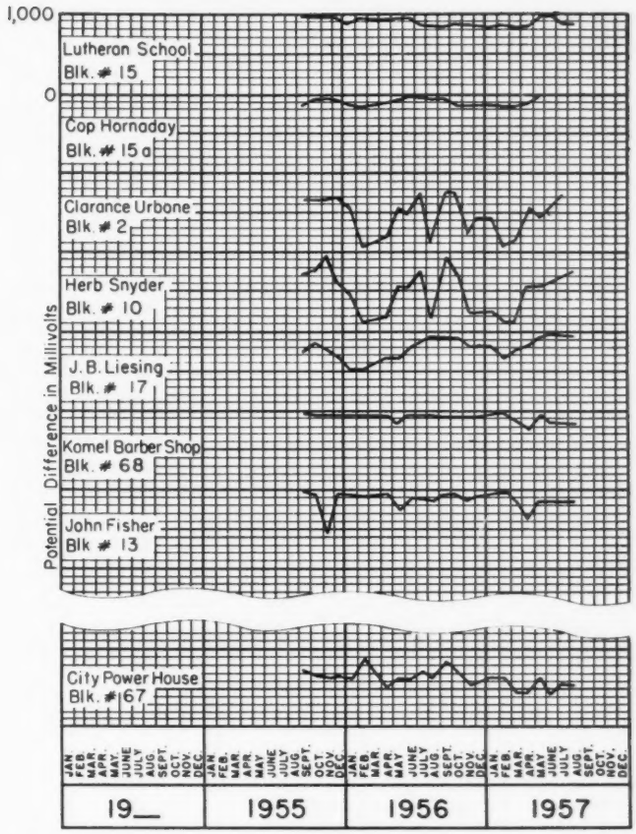


FIG. 7. Example of typical monthly check report, Arapahoe, Nebraska.

Record Keeping

A complete corrosion record file of all the towns is kept in the chief corrosion engineer's office. Each division manager, division corrosion technician, or local or district manager also keeps a corrosion file on those towns in which they are directly interested.

Fig. 1 illustrates the use of the town maps to record isolated sections, approximate anode locations and isolating joints. Each section is color-coded so that it is readily recognized. Generally, towns are piped for intermediate pressure (up to 25 psig). Some special loads require high-pressure lines (up to 150 psig). In the larger and more highly developed business districts, low-pressure (4 to 6 oz) systems are installed. All three may exist in some towns, but they are always isolated from each other at appropriate regulator settings.

Fig. 1 illustrates the legend of symbols used on the maps and in the block card books. Type of isolating joints, anode size, location, and date of installation are shown in some detail in the block cards.

Fig. 2 illustrates the application of data to the block card record. Anode size, location, date of installation, and approximate current output is also kept on file cards.

Fig. 3 illustrates the use of the maps of older "bare" towns to record coated-and-wrapped pipe replacements and extensions. All coated and wrapped lines are color-coded with a red line. Each protected section is color-coded. By color-coding the map in this manner, a simple reference is readily available from which it is possible to determine the desirability of extending projected replacements to existing protected sections, or to prevent the nuisance of small, impractical bare sections between protected sections. It may be economically feasible to replace such small sections while the crew is working nearby, and thus improving or modernizing the system at relatively small additional cost.

This coding method is a handy reference to determine the desirability of adding new work to an existing protected section, or possibly to show the need for isolating the new work and starting a new treatment section. Continued addition to an isolated and protected section eventually reaches a limit and new treatment sections are desirable.

Leakage Surveys

The company has set up a two-man leakage survey team in each of four divisions for the specific purpose of making leakage surveys of each town once a year. Provided with explosimeters, pipe locators, potentiometers, and resistivity instruments, the crews are taught some of the routine uses of these instruments. They locate the leaks, fixing only the bad blowers or dangerous ones in a temporary manner, and report them on maps, as in Fig. 4. These teams determine the approximate extent of the trouble, code the leakage map, and work up a summary report of existing conditions.

Fig. 4 presents an example of the leakage map coding. Direct cooperation of the corrosion technician, leakage team, and maintenance personnel is invaluable in arriving at practical decisions for the effective maintenance and protection of the ailing system.

Even after getting corrosion control installations made on a distribution system, it cannot be safely assumed that the protection will be effective and undisturbed for a long period of time. Many things can happen to completely upset the successful protective scheme. Constant surveillance is important. A monthly checking procedure has been established that can be carried out by a local service man with the instruments that he uses in his normal service work.

A few weeks after a new system is completed — and after the protection has had a chance to stabilize — a corrosion technician makes a complete survey of the new work, clearing any trouble that may exist. When the new protection is properly functioning, he then sets up several test locations in each isolated section. Each month, the local service man reads and reports the potential differences across the appropriate insulating joints.

Monthly Checks

Fig. 5 illustrates the monthly check report form. The report form shows the town, date of check, the street address or name of customers at each check point, and in their proper section. When the forms are printed, the original or last annual check by the corrosion technician is included, showing the pipe-to-soil potential of the protected pipe, the unprotected pipe, and the potential difference of the two in millivolts. The potential difference reading is made with the millivolt meter used by the reporting service man and not by a sensitive potentiometer.

If a short circuit or foreign contact is found on a protected section, the service man notes it when he makes his monthly potential difference tests. He has been taught the technique of locating such trouble, and usually does get it cleared without help. If he cannot locate the trouble, a corrosion technician will assist him in correcting it. Working with the local men on these problems not only promotes a stronger regard for corrosion control procedure and improving company-wide understanding, but also provides an effective training method as well.

After monthly potential difference readings are entered on the form, copies are sent to the local file, the division distribution manager, the division corrosion technician, and the chief corrosion engineer.

At least once each year, the corrosion technician makes a complete check of each town in his division, making any necessary changes in reading for each test point and adding any new ones that may be appropriate. A new supply of monthly report forms is also sent out to the local offices, and the annual reports are filed.

Monthly potential difference reports are recorded (in a loose-leaf notebook) as shown in Fig. 6 and 7. By keeping this record for several years, the seasonal affect on treatment, changes in current requirements, changes in anode current output, etc., are recognized in the potential trend. Any notes of interest affecting the history of the treatment may be kept on a fly sheet opposite each town record. Recording and use of the data kept in a notebook is much more convenient than if it were kept in files.

If the local people fail to send in one or more monthly check reports, a reminder card is sent out to them. Usually, it has been found, the tests were made but not sent in.

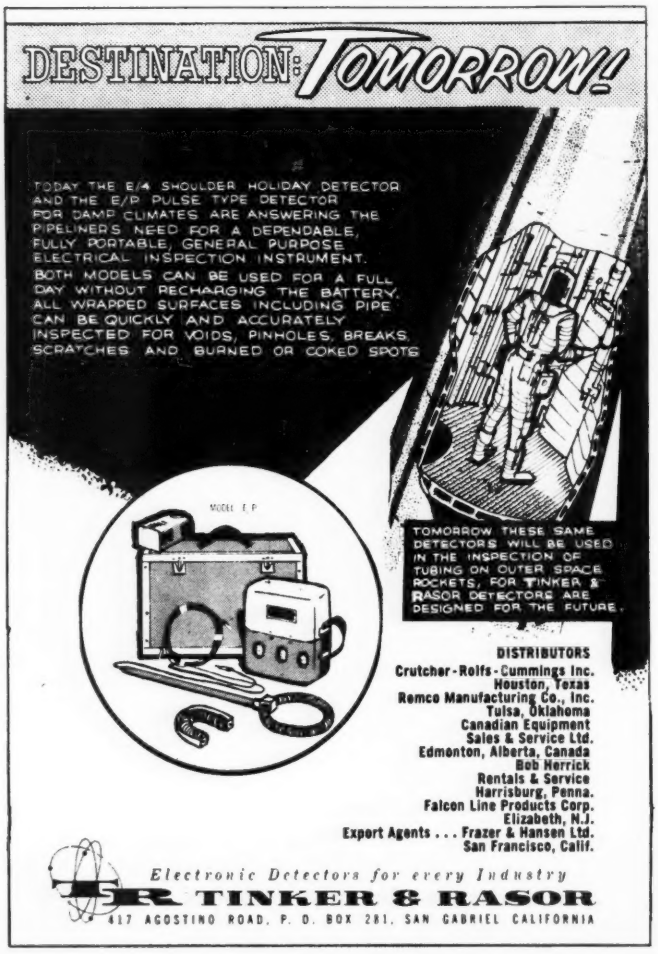
Preferred company practice is to maintain at least 1.0 volt potential pipe to $CuSO_4$ electrode on coated lines and at least 300 millivolt change from original potential on bare pipe. The limitations on pipe-to-soil potential criteria are recognized, but it is a simple and useful procedure to use in check reports. In monthly checks of potential differences across a customer's insulating joint, another large structure (the water system) is actually used as a reference, recognizing the fact that it may change but not enough to be of practical significance if the test points have been well chosen.

Summary

In summary, records are not only valuable, but whether simple or elaborate — depending on the need or the facilities — records are essential to any successful operation.

Acknowledgment

This article has been adapted from a discussion presented by the author at the NACE South Central Region Meeting, Oklahoma City, Oklahoma, October 1957, entitled *Records Related to a Natural Gas Distribution Corrosion Control Program*, and which was published in the October 1957 issue of CORROSION. ★ ★ ★


DESTINATION: TOMORROW!
TODAY THE E/4 SHOULDER HOLIDAY DETECTOR AND THE E/P PULSE TYPE DETECTOR FOR DAMP CLIMATES ARE ANSWERING THE PIPELINER'S NEED FOR A DEPENDABLE, FULLY PORTABLE, GENERAL PURPOSE ELECTRICAL INSPECTION INSTRUMENT.
BOTH MODELS CAN BE USED FOR A FULL DAY WITHOUT RECHARGING THE BATTERY. ALL WRAPPED SURFACES INCLUDING PIPE CAN BE QUICKLY AND ACCURATELY INSPECTED FOR VOIDS, PINHOLES, BREAKS, SCRATCHES AND BURNED OR COKED SPOTS
TOMORROW THESE SAME DETECTORS WILL BE USED IN THE INSPECTION OF TUBING ON OUTER SPACE ROCKETS, FOR TINKER & RASOR DETECTORS ARE DESIGNED FOR THE FUTURE.
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Normac insulating Brass compression end Tees, Ells and all compression end fittings are available with polyethylene inserts and semi-insulating or full insulating rubber gaskets in ¾", 1" and 1¼" iron pipe sizes.
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DISTRIBUTION DEVELOPMENTS

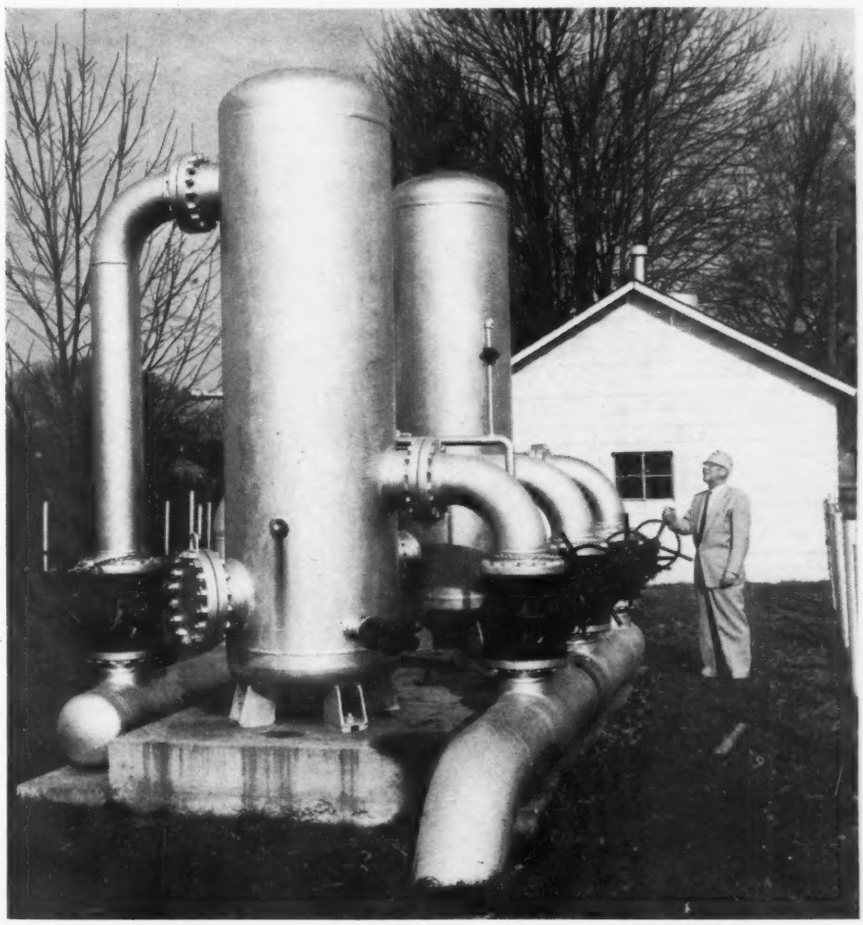
NEWS ABOUT CURRENT AND PLANNED CONSTRUCTION

Public Service Electric and Gas Company, Newark, New Jersey, plans to spend approximately $25,000,000 in 1959 to install more than 300 miles of gas mains, 23,000 services and 28,000 meters to serve an additional 27,000 heating customers. In 1958, more than 25,000 gas heating installations were added bringing the total number of gas heating customers to approximately 245,000. Company currently serves a total of 1,100,000 customers. Program of converting customers' appliances from use of mixed gas to straight natural gas in certain areas will continue during 1959 with nearly 146,000 additional customers affected. By the end of 1959 about 490,000 customers will be served with straight natural gas.

Alabama Gas Corporation, Birmingham, Alabama, has programmed $5,000,000 for new plant and equipment, and extensions to its distribution system in 1959. Company also plans to continue aggressive promotion of gas appliance sales with a budget of $1,200,000 scheduled for direct sales promotion. This is up from $430,000 budgeted for 1958, initial year of program.

Public Service Company of Colorado, Denver, Colorado, plans to spend more than $8,000,000 for construction of new gas facilities in 1959.

Southern Counties Gas Company, Los Angeles, California, plans to spend $31,100,000 in 1959, $7,000,000 more than in 1957, its previous record year. In 1958, company spent about $18,800,000. Of the 1959 budget about one-third — $10,600,000 — has been allocated for new mains, services, and other equipment to bring gas to about 140,000 new customers. Other major budget items are $3,532,000 for replacement or relocation of older distribution mains; and $2,376,000 for new buildings including provisions for the 13-story headquarters building scheduled to be completed in late 1959. Budget reflects rate of growth of areas served by company's eight operating divisions. Fastest growing is Orange County division where company plans to spend $5,570,000 to connect 17,000 new meters. Other division budgets are: Eastern, $2,016,000; San Gabriel Valley, $1,842,000; Santa Monica Bay, $1,214,000; Ventura County, $997,000; Northern, $710,000; Santa Barbara, $573,000; and Harbor division, $350,000.



New Gas scrubber, capable of cleaning 550,000 cu ft of gas per hr, is inspected by E. D. Godfrey, manager for Ohio Fuel Gas Company at Mt. Vernon, Ohio. Scrubber installation, one of three projects completed at Mt. Vernon to improve gas service in that city, cost $4270, doubles capacity of the city gate station in background. Other projects — costing nearly $7000 — included construction of about 3000 ft of 4-in. gas main to serve a new industrial plant of the Kieckheffer-Eddy Division of Weyerhaueser Timber Company and a building to house regulator equipment at plant, which is using gas for heating.

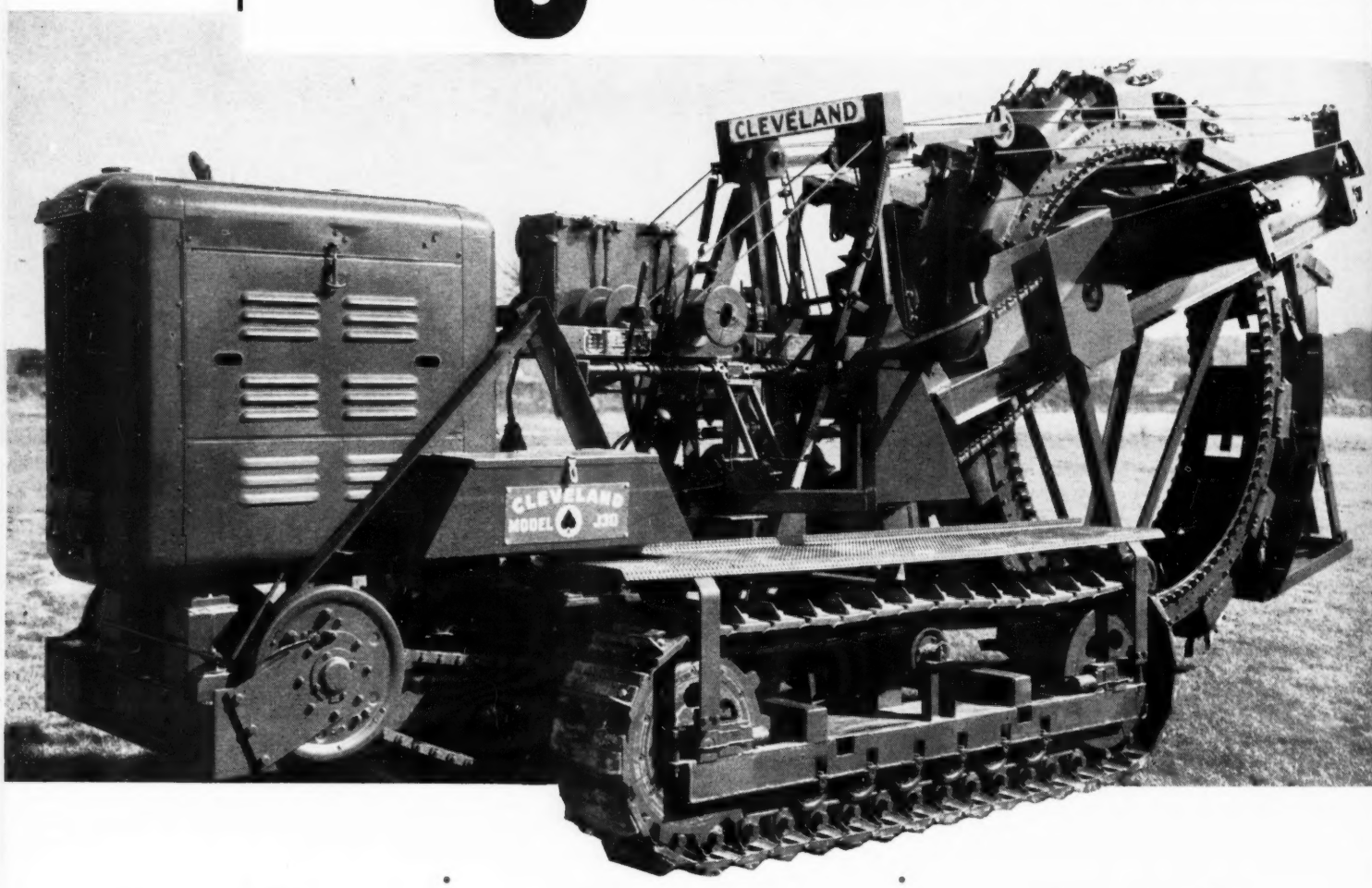
Southern California Gas Company, Los Angeles, California, has set a record construction budget of $56,856,000 for 1959. Major budget items include $13,000,000 tabbed for mains, meters, and services to supply some 50,000 new customers; $11,000,000 for upgrading and replacement of extant facilities; $200,000 to cover increased paving costs in the Los Angeles area. Main extensions for new business will add another $133,000 for the Palmdale Air Base; $123,000 for the Lemoore Naval Air Station; $100,000 for two San Joaquin Valley communities, New London, and Stratford. About a million dollars is labeled for new buildings and improvements; $225,000 for purchase of property in Riverside, and $125,000 to complete the Canoga Park operating base.

Illinois Power Company, Decatur, Illinois, plans to spend $36,000,000 for capital improvement in 1959 and $200,000,000 over the next five years. Of the $36,000,000 budgeted for this year, $9,200,000 is for improvements in its gas distribution system.

City Utilities of Springfield, Missouri, has number of projects on its gas distribution system that are underway or recently completed, including 12,350 ft of 2, 4, and 6-in. mains and feeder lines in various projects; 27,000 ft of 2 and 4-in. mains and services in subdivisions, 15,155 ft of 4, 10, and 12-in. main installed in one phase of its feeder loop program, and 6275 ft of 1¼ through 10-in. mains installed as part of an urban highway relocation project. All work being done by CU crews.

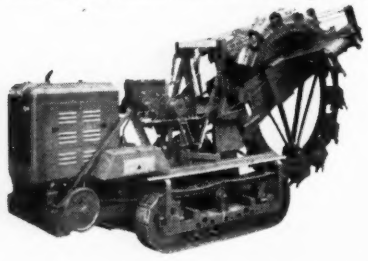
Announcing

3 GREAT NEW



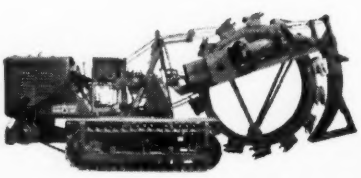
The J-20

Width over crawlers ..... 4′ 10″
Crawler length, C.C. ..... 6′ 3″
Overall length .....21′ 6″
Width of crawler shoe ..... 10″
Weight ..... approx. 13,500 lbs.
Ground bearing pressure ..... 8.8 psi.
Cuts trench 13″ to 24″ wide, to 5′ 6″ deep
Principal applications:
urban areas, utilities lines, services, extensions, mains, house footings, etc.



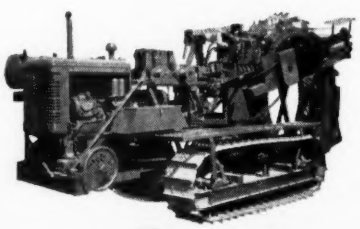
The J-30

Width over crawlers ..... 6′
Crawler length, C.C. ..... 6′ 9″
Overall length .....22′
Width of crawler shoe ..... 14″
Weight ..... approx. 15,000 lbs.
Ground bearing pressure ..... 6.5 psi.
Cuts trench 13″ to 24″ wide, to 5′ 6″ deep
Principal applications:
suburban areas, drainage, utilities, gathering lines, footings, septic tanks, leach beds.



The J-40

Width over crawlers ..... 8′
Crawler length, C.C. ..... 7′ 6″
Overall length .....23′
Width of crawler shoe ..... 18″
Weight ..... approx. 18,800 lbs.
Ground bearing pressure ..... 5.6 psi.
Cuts trench 17½″ to 30″ wide, to 5′ 6″ deep
Principal applications: trench up to 30″ wide —pipelines, waterlines, drainage, irrigation, sewer lines, utilities.



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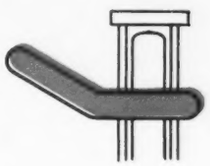
with ...revolutionary new V conveyor

...world's finest trencher crawlers

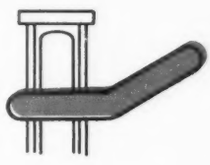
...all operations controlled at operator's seat

V CONVEYOR ... provides maximum clearance under digging wheel rims ...allows higher heaped loads without clogging ... provides constant elevating angle for faster, higher spoil discharge ... reduces rolling and tumbling ... has stronger torsion-free construction ... employs huskier, longer-lived bearings.

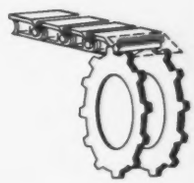
AUTOMATIC CONVEYOR SHIFT ... operator controls hydraulic shifting and positioning of conveyor ... digs past poles, trees, shrubs ... places spoil where needed ... *all* without leaving seat, without interrupting other operations.



DUAL INDEPENDENT CONVEYOR DRIVE ... identical, self-contained hydraulic motor and planetary gear drives in each head-pulley eliminate *all* conveyor chains and sprockets ... reduce belt slippage and wear ... furnish operator fingertip control of conveyor belt direction and speed (215-1,000 fpm) independent of all other operations.



FINEST CRAWLERS ON ANY TRENCHER ... employ double flanged wheels, rollers and sprockets with wide-spaced teeth ... drives on each end of 1½" dia. hardened pins ... completely eliminates pockets for dirt, stones, etc. ... eliminates take-up devices ... gives greater track stability ... lengthens wear life ... sprockets, wheels and idlers ride on sealed ball or roller bearings requiring only 200-hour lubrication ... a tremendously long-lived, trouble-free, easy-rolling crawler track.



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HYDRAULIC CRUMBING SHOE ... now, crumbing shoe advantages (cleaning, grading) are practical even in crowded digging ... Cleveland's hydraulic shoe control (optional, extra) pivots shoe back and up to allow setting wheel to required depth at walks, drives, underground obstructions, etc.

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... Every Operation Controlled at Operator's Seat.

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Everywhere

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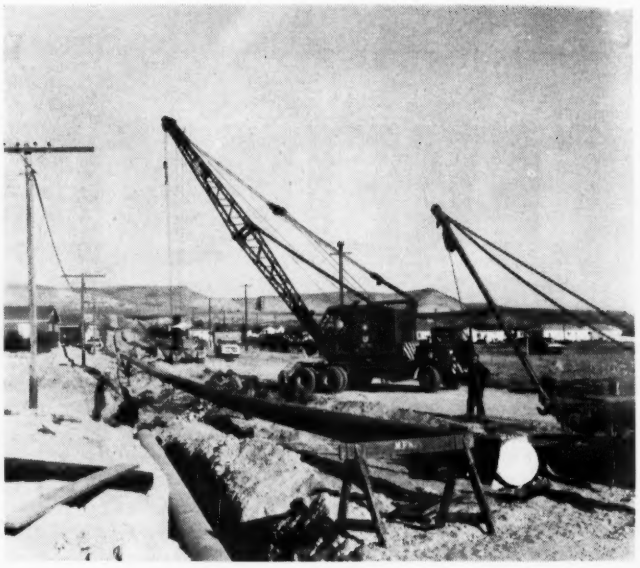
Cleveland 17, Ohio

New 20-in. line lies alongside open trench adjacent to Green River housing area. It replaced old 18-in. line laid in 1929.



Truck-mounted crane, tractor, and truck with A-frame team up to lower-in the 20-in. line through a dry-wash.

Modernization at Green River Upgrades Line to Meet Code 'Specs'

H. M. McCamish, *Mountain Fuel Supply Company, Salt Lake City, Utah*

DURING MODERNIZATION of measuring and regulating equipment at its Green River station, Mountain Fuel Supply Company's workmen also replaced a section of high-pressure line through a housing area adjacent to the station. The work was done to improve the safety factor of this portion of the system in accordance with the latest A.S.A. code requirements.

The project involved replacement of approximately 2700 ft of 18-in. pipe, installed in 1929 with a like amount of 20-in. pipe having a test pressure rating of 1120 psig. Trench for the new line was dug parallel to the old line, the 20-in. pipe was welded together alongside the ditch, and wrapped with plastic type tape, and the pipe was then lowered into the ground and partially back-filled.

A 16-in. block valve assembly was welded into the line on each side of the Green River station meter house and a 16-in. meter tube and fitting, having a test pressure rating of 1200 psig, was welded between the two valve assemblies. A 10-in. bypass was laid around the meter equipment in the event it became necessary to take the station out of service.

During the work, gas supply for the system was routed around the station area in the original 8-in. bypass installed in 1929 and fed into an 18-in. main at the downstream edge of the station property. The line carries gas from the Wyoming fields to the company's primary distribution area at Salt Lake City, Utah.

After installation of the pipe and measuring equipment was completed, and before being put into service, it was filled with water and hydrostatically tested to 1010 psig.

The water was then purged out with gas and the line tied into the pipeline system at each end and put into service. The 18-in. pipe from the old line was removed from the ground and backfilling and clean up of the right-of-way completed.

Included in the changes at the Green River station was the installation of a new 4-in. meter tube, orifice fitting and regulators through which natural gas is furnished to the town of Green River. * * *

Old 18-in. line is pulled out of its trench after new 20-in. pipe had been installed.

BELIEVE ME... M-F HAS THE Right Approach on HOW TO MAKE MONEY WITH A BACKHOE

Most backhoes will dig – and, they'll dig themselves into a "hole," too.

But, with this M-F Work Bull 202 rig and matched Davis Loader-Backhoe, you simply can't get cornered! Thousands have proved it!

First of all, the Davis 210 Backhoe has a hydraulic rotary swing cylinder with a continuous 200° working radius – digs or dumps at right angles to either side.

When you run into a situation that calls for digging flush alongside a wall, fence, hedge, or other obstacle – you simply move the mast and boom assembly to either end of the frame and continue right on digging. No need to call in a pick and shovel crew.

It develops up to 10,000 pounds of breakaway – handles the hardest soil, frozen ground, or asphalt paving.

Notice, you sit where you can see, and you always face the bucket.

The M-F Work Bull and Davis Loader completes the profit picture. You get out more work – than with any other rig.

Your Massey-Ferguson Industrial Dealer can help you select the right outfit, and he'll back it up with service. Write today for free literature; his name and address.

Work Bull 1001 Work Bull 303 with 500 Loader and Davis Backhoe Work Bull 202 with Davis Loader and Backhoe Work Bull Fork Lift

MASSEY-FERGUSON INDUSTRIAL DIVISION

1009 SOUTH WEST STREET • WICHITA 13N, KANSAS

On the job, and self-sufficient for most tasks, "Big Mamie" proves that time and effort spent in custom-designing a street service vehicle is worthwhile.

Big Mamie — Pride of Worcester Gas

"BIG MAMIE" (who tips the scales at 14,650 lb) is a favorite with the distribution department of the Worcester Division of Worcester Gas Light Company. "Big Mamie," incidentally, is their newest street service truck. She was delivered to the Worcester Company of the New England Gas and Electric Association recently, and exemplifies the modern thinking of both NEGEA motor vehicle supervisor G. P. Jackson, and personnel of the operating gas departments.

The vehicle, with less than 21 ft overall length, combines a heated 4-man crew compartment, an enclosed compressor compartment, and 97 in. of clear body floor space. The body itself utilizes the maximum amount of cabinet and storage space, while the center floor space is equipped with long tool cabinets having seat covers to carry additional workmen. Both sides of the body are equipped with bins and compartments for fittings and tools. The underbody thru-boxes carry long tools and equipment.

The unit is equipped with a 125-ft rotary compressor with clutch and adapted for cross mount installation. It is mounted so as to be readily removable from the body for major servicing. All controls are located on the curb side.

The air compressor's 4-cylinder engine and the truck engine are both equipped with heavy duty generators to provide power for all the electrical equipment, including lights, radio, etc.

Two different sources, therefore, are available to furnish the heat and electrical power requirements: The truck's engine when the truck is running, and the compressor engine when the truck is not operating.

The vehicle is equipped with a 1000-lb swinging crane for handling heavy valves and fittings.

Crew compartment of the vehicle is insulated, ventilated, and heated, and a stainless steel insulated water cask supplies fresh drinking water.

Compressor truck equipment includes two jack hammers, two light paving breakers and two clay diggers.

The truck carries ¾ to 4-in. pipe at all times. The rear of the vehicle is equipped with a hoist, and on each side of the truck are extension cord outlets, so that night jobs may be sufficiently lighted.

The truck has short-wave radio equipment, equipped with a "selective signaling" device.

After actual service testing, Worcester Gas Light management is satisfied that the time and energy spent in the planning and developing this modern street service unit was worthwhile and will enable the company to render better customer service. * * *

Dressed in her Sunday best, "Big Mamie" poses for a formal photograph before her shakedown cruise and assignment to Worcester Gas' distribution department duties.

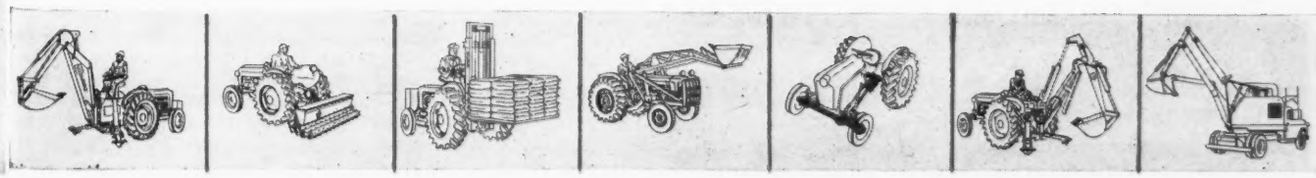
More than 15,000 Sherman Power Diggers—a figure not even approached by any other backhoe manufacturer—have demonstrated their capacity to excavate more economically. Find out today how the Sherman Power Digger can save you money.

Write for Bulletin No. 3188

Sherman Products

SHERMAN PRODUCTS, INC., Royal Oak, Michigan

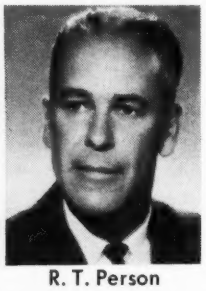
POWER DIGGERS • LOADERS • SOIL WORKING TOOLS • FORK LIFTS
CRANES and EXCAVATORS • FOUR-WHEEL DRIVES



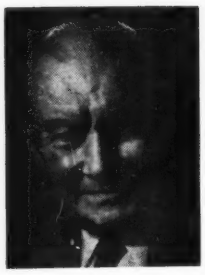
MEN AT WORK

IN THE GAS DISTRIBUTION INDUSTRY

J. E. Loiseau



R. T. Person



W. D. Virtue

W. W. Howell

● **John E. Loiseau** has retired as president of Public Service Company of Colorado, and **Robert T. Person** has been elected to succeed him as president. Loiseau has been elected chairman of the board of directors. Duties for **William D. Virtue** have been expanded, placing him in charge of company operations. He will continue to serve as treasurer and principal financial officer of the company. **Walter W. Howell,** assistant vice president, has been advanced to succeed Virtue as principal accounting officer.

● **Lew E. Libby,** sales training director of Oklahoma Natural Gas Company, has been promoted to director of sales promotion. Prior to joining Oklahoma Natural in 1957, Libby had been with Servel, Inc. **M. H. "Hal" North** has been named director of advertising and **John C. Deupree** assistant to the director of advertising. **Charles H. Rich,** Shawnee district vice president, has retired due to ill health and **Wayman E. Humphrey,** Muskogee district sales manager, succeeds him as vice president of the Shawnee district. Humphrey's successor in Muskogee has not yet been named.

● Robertshaw-Fulton Controls Company has announced recent personnel changes: **John C. C. Byrne** has been elected vice president, finance, and **Milton E. Case,** former assistant controller to succeed Byrne as controller . . . **John D. Baker, Jr.,** senior partner, Reynolds & Company, has been elected to the board of directors replacing **Thomas F. Staley,** who has resigned because of the pressure of business commitments elsewhere . . . **Arnold C. Hansen** has been promoted to assistant to the general manager of the Grayson Controls division. He will continue to represent Grayson division in connection with the company's national service program.

A. C. Hansen

● Philadelphia Gas Works has elected **Robert W. Lobb,** manager, customer relations department, and **Stephen C. Symnoski,** superintendent, Station A, to membership on its executive staff. Symnoski was recently promoted to superintendent of Station A following the retirement of **Walter A. O'Donnell.** Lobb, was recently appointed manager of the new customer relations department . . . Dissolvement of the commercial department has resulted in establishment of three new departments, a collection and meter reading department, customer accounting department, and customer relations department. **Francis T. Hager,** former manager, collection, and meter reading section, has been appointed manager, collection and meter reading department; **Elmer F. Sahlender,** former manager, customer accounting section, has been appointed manager, customer accounting department, **Robert W. Lobb,** former assistant manager, general accounting department, has been promoted to manager, customer relations department, and **Harry J. Schmidt,** formerly a technical assistant, has been promoted to assistant manager of the general accounting department. **Daniel B. Allison** former manager of commercial department has been re-appointed assistant to the director of finance and accounts . . . Also announced was realignment of executive structure with promotion of **Edward F. Hubbard,** former director of administration, to the newly created post of director of operations in charge of the customer service, distribution, and production departments. **Hammitt L. Robbins,** former director of services, replaces Hubbard as director of administration and **Robert R. Lockhart** moves up to the post of director of services and **Frederic D. Justin,** succeeds Lockhart as assistant director of finance and accounts.

● Recent personnel changes announced by the Ohio Fuel Gas Company include four distribution department changes — **I. A. Ludwig,** vice president and Toledo district manager, has retired from active participation in operation of the Toledo district. **H. C. Taylor,** Elyria district manager, succeeds Ludwig as Toledo district manager. Ludwig will retain his vice presidency and will work on administrative assignments from the company general offices in Columbus. **Donald E. Barr,** Springfield division manager succeeds Taylor as Elyria district manager, **David E. Young,** assistant Toledo district manager, succeeds Barr in Springfield . . . **Howard S. Riddle** has been appointed coordinator of material standardization for Columbia Gas System Service Corporation. He will also handle work of material coding . . . **Harry S. Metier,** Circleville manager, has retired and **Douglas R. Cotterman,** an engineer in the industrial department at Athens, has been named to succeed Metier . . . **Harold W. Haught** has been named local manager for O-F's Chillicothe office. For the past 10 months, Haught has been local manager in Berea. In his new post, he succeeds **James W. Cole** who has been appointed Bellaire division manager of Ohio Valley Gas Company, a sister subsidiary of Columbia Gas System . . . **William E. Ferguson,** vice president and manager of production in charge of production operations and underground storage program, retired January 1 after a 41-year career.

● Four recent promotions at Roanoke Gas Company are: Election of **Arthur T. Ellett** to vice president and general manager of the company; **Edward C. Dunbar** to secretary and treasurer succeeding Ellett; promotion of **Charles D. Koontz** from engineering assistant to utilization and supply engineer, and **David B. Stuart** from engineering assistant to construction engineer.

● **Gordon L. Calderwood,** formerly engineer of gas production, has become Rochester Gas and Electric's assistant director of safety.

● **Donald B. Robertson** has been appointed advertising manager of Southern Counties Gas Company to fill the vacancy created by former advertising manager **Homer Laughlin's** decision last August to go on company's disability rolls because of his health.

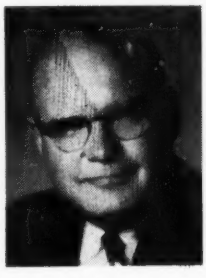
● **J. W. (Bill) Carneal,** formerly assistant director of sales and customer relations for Texas Gas Transmission Corporation, has been appointed director of sales and industrial development.

● Western Kentucky Gas Company has appointed **Zane G. Carlisle** manager of the air conditioning department to organize an air conditioning staff and supervise sale and installation of gas air conditioning equipment in the 55 communities served by the company . . . **Frank Cassada** has joined Western Kentucky as a sales supervisor for residential gas appliances.

● **William H. Stewart,** former district manager in Seattle, Washington, has been appointed Philadelphia district manager for Burroughs Corporation's ElectroData division.

E. E. Lungren

E. D. Sheehan



C. F. Henness

L. W. Tuttle

● Northern Illinois Gas Company has announced the following changes as the result of the retirement of executive vice president, **Edgar E. Lungren. Edward D. Sheehan,** present vice president in charge of operations, has been appointed to succeed Lungren. At the same time, **Charles F. Henness** and **Loren W. Tuttle** were named vice presidents. Henness will be in charge of divisions, and Tuttle in charge of operation.

● **Dr. Philip P. Anderson** has been appointed chief engineer for Arkla Air Conditioning Corporation. Formerly, he served in various research and engineering executive capacities with Servel from 1936 through 1956. Since that time, he has served as director of development for Carrier Corporation.

P. P. Anderson

Leonard Milano

● **Leonard Milano,** director of Quebec Natural Gas Corporation, has been appointed executive vice president of that corporation succeeding **Kenneth B. Lucas** who has resigned to enter the consulting field. Lucas will continue with the company as a consultant and member of the board of directors.

● Northwest Natural Gas Company has broadened responsibilities of **Charles R. Holloway Jr.,** vice president of marketing to include also customers office, customer service, and district offices outside Portland. **Donald W. Hosford** has been advanced to general sales manager from manager of direct customer sales, and **C. W. (Bob) Steel** has been named assistant to vice president Holloway to supervise nine district offices and take on special assignments; **Willard J. Mayfield** is new assistant to president **Charles H. Gueffroy,** while retaining his duties of the past three years as director of industrial relations.

● **Carroll W. Wright** has been appointed acting manager of Citizens Utilities Company's Colorado gas properties, and will headquarter in La Junta, Colorado. His appointment followed the death of Donald W. Hamilton, who had held the same position since 1949. Wright will also continue as manager of the Rocky Ford district. **John R. Willowby,** office manager of the Colorado district, has been appointed assistant manager.

● **William A. Haist, Jr.** has been appointed president and general manager of the Sprague Meter Company, succeeding **F. Leslie Fairchild** who retired last October.

W. A. Haist Jr.

E. N. Wrenshall

● **Edward N. Wrenshall** has been appointed to the newly established office of general manager of Kerotest Manufacturing Company. He will direct and coordinate all activities of both the steel and brass divisions of the valve manufacturing company.

● **John P. Crowley,** formerly vice president of Greenwich Connecticut Gas Company, has been named vice president-sales of North Carolina Natural Gas Corporation. He will direct sales, public relations, and promotional activities of the company which is now launching a cross-state pipeline construction project to bring natural gas into 31 central and eastern North Carolina communities.

● **David J. Davis** has been appointed director of sales and advertising for Gar Wood Industries. He was formerly tractor equipment sales manager, and later general sales manager, construction machinery.

● **Norman J. Kirk** has been appointed president and general manager of Toledo Pipe Threading Machine Company.

● Northern Ontario Natural Gas Company, Limited, has appointed three division business manager: **William Scott** for the Muskoka division; **L. W. Luke** for the Nickel division and **A. R. Smith** for the Porcupine division.

● **William F. Weimer** has been appointed to a new position of director of public relations and advertising for Rockwell Manufacturing Company. He was formerly advertising manager of Rockwell's Meter and Valve, Municipal and Utilities and Register Divisions.

W. F. Weimer

R. O. Branam

● **Ray O. Branam** has been elected vice president and director of Midwestern Manufacturing Company. He was formerly general manager in charge of engineering, production, and sales.

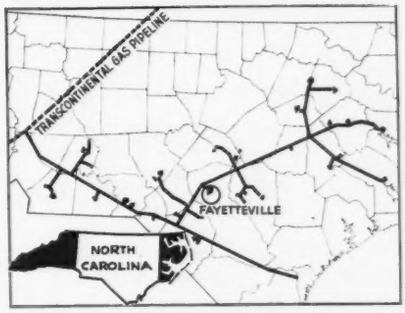
● **Nicholas Kay** has become division vice president of Koppers Company, and simultaneously assistant general manager of the metal products division.

● **Howard J. Goss** and **John F. Roggenkamp** have been elected new vice presidents of Harper Wyman Company. Goss, former sales manager, will be vice president in charge of sales and Roggenkamp, former Chicago plant manager, will serve as vice president in charge of operations.

● **Harry V. Seevers** and **Paul L. Hines,** both sales representatives, have retired from Mueller Company . . . **Dan R. Gannon** has been elected vice president and general sales manager for the company . . . **Odie E. Walker,** vice president and works manager, has been named executive vice president and general manager for the Canadian subsidiary, Mueller, Ltd., in Sarnia, Ontario.

Alexander Forward

Alexander Forward, retired managing director of the American Gas Association, died December 21 at Coral Gables, Florida. He had served 22 years as A.G.A.'s managing director before his retirement in 1945.



SOMERVILLE on the job in North Carolina

You'll find the familiar sign of the Somerville diamond "S" in North Carolina. Our spreads are now at work on a major portion of North Carolina Natural Gas Company's transmission system.

This project demonstrates that Somerville experience and efficiency count in getting a project kicked off on schedule.

Project Office, Fayetteville

SOMERVILLE CONSTRUCTION CO.
Ada, Michigan
SIGN OF SATISFACTION
TRANSMISSION LINES
DISTRIBUTION SYSTEMS

1897 1958

GOODMAN
USED SINCE 1897
2" HANDLE & LOCKING SLEEVE
GAS MAIN STOPPER

PIPE STOPPERS OF ALL KINDS

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SAFETY GAS MAIN STOPPER CO. INC.

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COMING EVENTS IN THE GAS DISTRIBUTION INDUSTRY

February

18 NEGA, street department supervisors' group of operating division, Bancroft Hotel, Worcester, Massachusetts.

March

2- 3 A.G.A. general management conference, Hotel Statler, Cleveland, Ohio.

4- 5 Gas Conditioning Conference, University of Oklahoma, Norman, Oklahoma.

4- 5 Gas Processing Conference, University of Oklahoma, Norman, Oklahoma.

5- 6 SGA distribution management round table conference, Jung Hotel, New Orleans, Louisiana.

6 SGA accident prevention round table conference, Jung Hotel, New Orleans, Louisiana.

8-11 ASME Gas Turbine Power conference and exhibit, Netherlands-Hilton Hotel, Cincinnati, Ohio.

9-11 Mid-West Gas Association, annual meeting and convention, Hotel Ft. Des Moines, Des Moines, Iowa.

16-20 NACE, Sherman Hotel, Chicago, Illinois.

19-20 NEGA, annual meeting, Hotel Statler, Boston, Massachusetts.

24-26 PCGA sales conference, Sacramento, California.

26-27 Oklahoma Utilities Association, annual convention, Mayo Hotel, Tulsa, Oklahoma.

26-27 Eighth Annual Instrument Short Course, sponsored by Southern California Meter Association, Los Angeles Harbour Junior College, Wilmington, California.

31-April 2 Corrosion Conference, University of Oklahoma, Norman, Oklahoma.

31-Apr. 2 American Power Conference, sponsored by Illinois Institute of Technology, Hotel Sherman, Chicago, Illinois.

April

1- 3 GAMA, annual meeting, Americana Hotel, Bal Harbour, Florida.

6- 7 Instrument Society of America, 2nd national symposium on chemical, oil, and gas instrumentation, St. Louis, Missouri.

6- 9 A.G.A. distribution conference, Netherland-Hilton Hotel, Cincinnati, Ohio.

7- 9 A.G.A. industrial and commercial sales conference, Hotel Warwick, Philadelphia, Pennsylvania.

10- Maryland Utilities Association, annual convention, Baltimore, Maryland.

14-16 Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, Oklahoma.

16- Pennsylvania Gas Association production conference, Drexelbrook Swimming and Tennis Club, Drexelbrook, Pennsylvania.

19-23 ASME Oil and Gas Power Division conference and exhibit, Shamrock-Hilton Hotel, Houston, Texas.

20-22 A.G.A.-EEI accounting conference, Sherman Hotel, Chicago, Illinois.

23-24 Indiana Gas Association, annual convention, French Lick-Sheraton Hotel, French Lick, Indiana.

27-29 SGA annual convention, New Orleans, Louisiana.

May

3- 6 LPGA annual meeting, Conrad Hilton Hotel, Chicago, Illinois.

5- 6 PCGA distribution conference, Santa Barbara, California.

5- 7 14th Purdue Industrial Waste Conference, Prude Memorial Union Building, LaFayette, Indiana.

5- 7 A.G.A. research and utilization conference, Cleveland, Ohio.

7- Symposium on Corrosion Inhibitors, Theory and Mechanism, sponsored by Armour Research Foundation and Chicago Section of Electrochemical Society, Illinois Institute of Technology, Chicago, Illinois.

11-12 A.G.A. eastern sales conference, Netherland-Hilton Hotel, Cincinnati, Ohio.

17-20 Industrial Heating Equipment Association, Inc., The Homestead, Hot Springs, Virginia.

18-20 AGA mid-west regional gas sales conference, Edgewater Beach Hotel, Chicago, Illinois.

18-19 A.G.A. transmission conference, Statler-Hilton Hotel, Dallas, Texas.

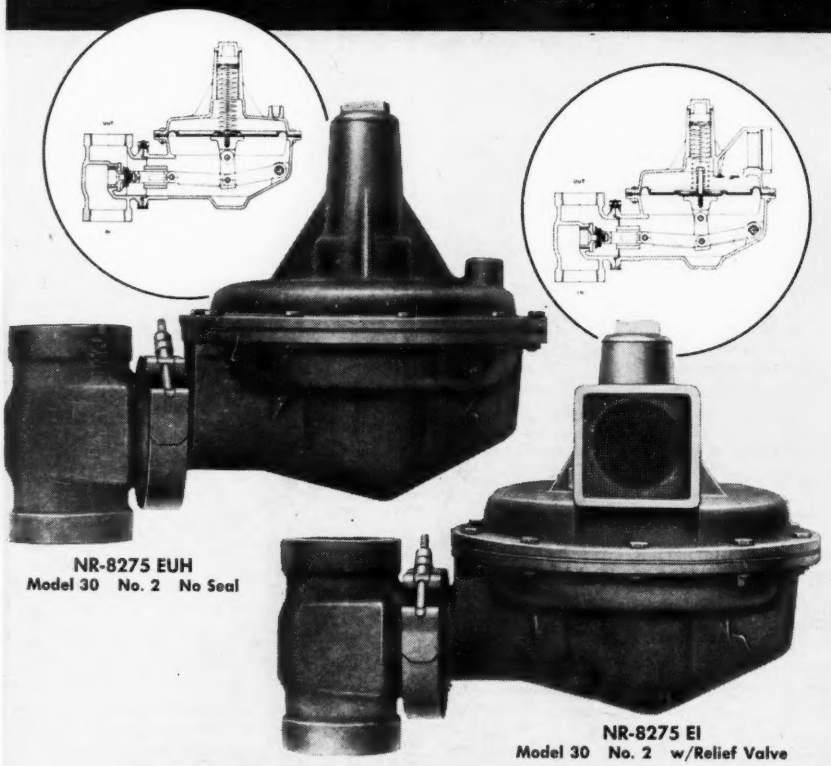
18-19 A.G.A. midwest sales conference, Edgewater Beach Hotel, Chicago, Illinois.

19-21 Pennsylvania Gas Association, annual meeting, Pocono Manor, Pennsylvania.

21-22 Natural Gas & Petroleum Association of Canada, annual meeting, Hamilton, Ontario, Canada.

REYNOLDS

NR 8275 SERIES... Regulator that has Everything!



NR-8275 EUH
Model 30 No. 2 No Seal

NR-8275 EI
Model 30 No. 2 w/Relief Valve

VARIATIONS IN CONSTRUCTION COVER ALL REQUIREMENTS

Inlet unit size 1" to 2" I.P.S. screw connection and 2" flange connection • 360° installation • Inlet pressure ½# to 125 psi • Outlet pressure 3" W.C. to 3 psig • Orifice range ¼" to ¾" • Capacity 500-3000 cubic feet under all inlet conditions • Built-in relief valve with 6000 cubic feet per hour, capacity, with 1 psi on meter • Four position vent location • Vent pipe size 2" with stainless steel screen • Stainless steel band clamp • Interchangeable with Reynolds NR-8310 Series.

GAS CONTROL SINCE 1892

REYNOLDS
GAS REGULATOR CO.
ANDERSON, INDIANA

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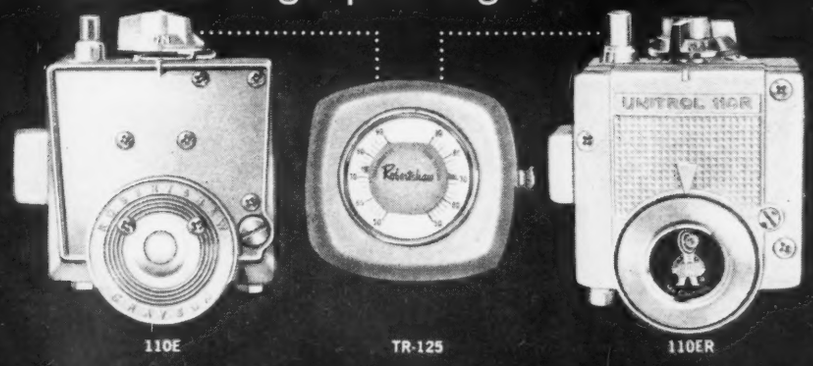
you specify

ROBERTSHAW

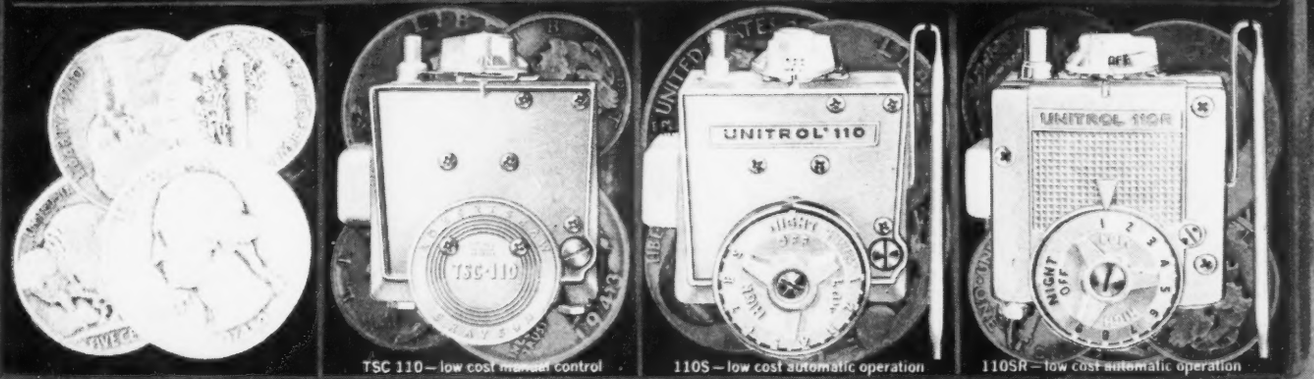
your savings show up here

✳a NEW savings package

✳ Announcing the new 110E (24 Volt, low cost electric space heater control) and the 110E-R (same as the 110E except with gas pressure regulator added), either to be used with the TR125 Wall Thermostat.



110E TR-125 110ER



TSC 110—low cost manual control

110S—low cost automatic operation

110SR—low cost automatic operation with gas pressure regulator

...a complete selection of reliable low-cost space heater controls

Robertshaw-Fulton
CONTROLS COMPANY

GRAYSON CONTROLS DIVISION • LONG BEACH, CALIFORNIA

PRODUCT PARADE

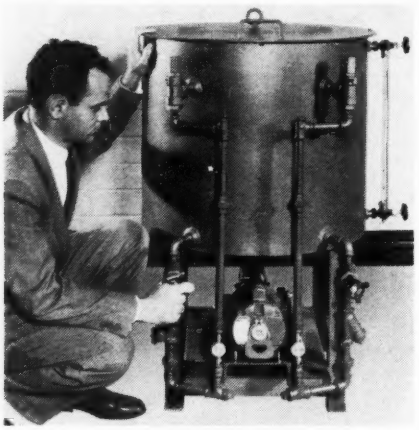
MATERIALS – EQUIPMENT – SERVICES

DUCTILE IRON, a new metal that combines corrosion resistance of cast iron with mechanical properties similar to those of steel is now available to the gas distribution industry from American Cast Iron Pipe Company, in a complete line of pipe, tubing, casting, fittings, and special castings. America's ductile iron products are first of their type to be manufactured in commercial quantities in the U. S. following an intensive 10-year program of research and development. Major application is for underground gas service mains where high pressures, extreme beam and crushing loads, unusual shocks and stresses, unstable bedding, and deep fills may be encountered. Under such adverse conditions, ductile iron pipe will twist and bend without breaking. Several hundred thousand feet of the new pipe have already been installed to meet super-service requirements. Pipe has ample wall thickness for direct taps into pipe wall without saddles or welding. Wide variety of joints are available that can be quickly and easily assembled and are "bottle-tight."

CIRCLE (11) ON THE REPLY CARD

JOSLYN'S ELECTRICALLY-CONDUCTIVE COMPRESSION COUPLINGS are designed to provide a low-resistance electrical joint essential to cathodic protection systems. Coupling combines all features of standard compression coupling and assures a sealed-in bond when compression nuts are tightened. Simple to install, fully re-usable, and permanently leak-proof, units include bond sealed within the coupling and are designed to have low electrical resistance. With a low power loss, coupling does not heat up or cause deterioration of gasket material.

CIRCLE (12) ON THE REPLY CARD



NEW PROPORTIONING PUMPS introduced by American Meter's Pump Division, have been developed to handle specific volumes of fluids ranging from .65 gal per hour to 13.10 gal at 1000 psi. Duplex models are rated at double these capacities. Under new "package system" arrangement, it is now possible to obtain both the proportioning pumps and standard feeder tanks of various sizes on a single order and eliminate one phase of installation piping.

CIRCLE (13) ON THE REPLY CARD

FOR MAINTAINING HEAT PROCESSING OPERATIONS during periods when "interruptible" gas supplies are cut off, Selas Corporation of America is now marketing a propane diluter that automatically supplies accurate mixtures of LPG-oil. Available for small, medium, and large installations, units provide simplified interchangeability without having to adjust appliances or gas burners. Units can be connected to existing gas piping and eliminate need for dual piping, separate air blowers, or inspirator mixers.

CIRCLE (14) ON THE REPLY CARD

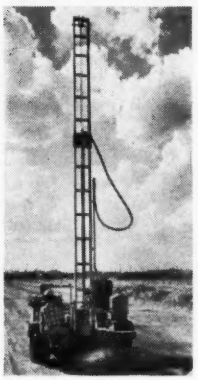
FISHER GOVERNOR COMPANY is now producing electro-pneumatic transducers for operating standard pneumatic control valves in an electrical control loop. Transducer utilizes a high capacity relay to produce a pneumatic output pressure that is proportional to a d-c milliampere input signal. This allows use of fast electrical transmission in conjunction with dependable and inexpensive pneumatic valve actuators.

CIRCLE (15) ON THE REPLY CARD

MAJOR PRICE BREAK IN ELECTRONIC COMPUTING has been achieved with introduction of Bendix Aviation's new data-processing system. Bendix has developed an accessory (called the CA-2) for its low-priced G-15 digital computer that gives punched-card data-processing capabilities to the computer. The complete system — consisting of a G-15, the new CA-2, conventional card readers and punches plus a tabulator —will lease for about $2500 per month. New CA-2 unit can process standard cards, punched with numeric, alphabetic or special character information, and provide complete computing system with 100-card-per-minute input and output, and 100-lines per minute tabulation.

CIRCLE (16) ON THE REPLY CARD

NEW SELF-PROPELLED ROTARY DRILL UNIT capable of drilling to 100 ft has been introduced by Drilling Accessory and Manufacturing Company of Dallas. Unit can be used on pipeline projects requiring continuous blasting; requires only one operator as all controls are centrally located at driver's position. Twenty-foot holes have been cut in 60 seconds, and rig moved to next hole ready for drilling in 30 seconds. Unit is mounted on pneumatic dual tires, is mobile, and easy to handle. Can drill holes from 2¼ to 3⅞-in. with variable rotary speeds from 25 to 325 rpm, and constant controlled down pressure.



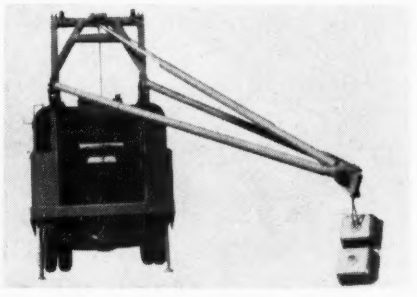
CIRCLE (17) ON THE REPLY CARD

POWER-DRIVEN PIPE TAPING MACHINE, capable of cleaning, priming, taping, and overwrapping small distribution pipe automatically, is available from Minnesota Mining and Manufacturing Company. Unit handled pipe sizes up to 2-in. in diameter and automatically performs the 4 operations on more than 2500 ft of pipe per hour. Designed for "in-the-yard-taping" with vinyl plastic, corrosion-protective tape, machine is called "Scotchrap" brand pipe taper, model E-7.

CIRCLE (18) ON THE REPLY CARD

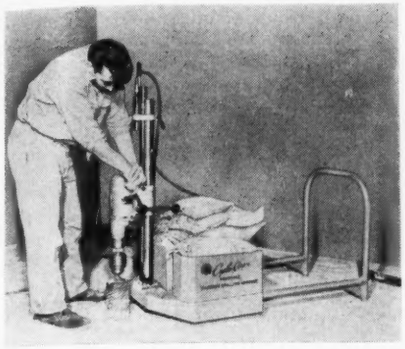
"JEWELED" ESCAPEMENT now available with all 31-day chart drives manufactured by Rockwell Manufacturing Company. This jeweled movement is the first ever used on a general industrial timing device manufactured in the U. S. and greatly increases accuracy of the chart drive. Little power is required to operate unit. Seven jewels provide accurate control of release of power of chart drive's mainspring thereby giving accurate time measurement. Chart drive is used for driving recording charts — particularly pressure flow and temperature recorders of the 7 to 31-day rotation.

CIRCLE (19) ON THE REPLY CARD



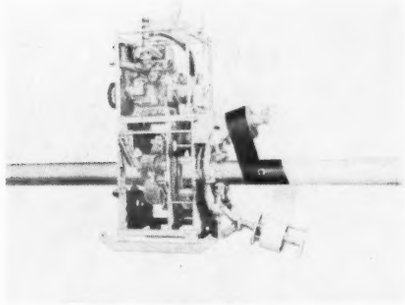
HYDRAULIC DERRICK with side movement allowing it to reach 9 ft to either side from center line of truck chassis is now available from Utility Body Company. New model provides sheave heights of 25, 27, or 29 ft. Simple extension of derrick side legs allows an additional 2 ft in each of these sheave heights. Derrick can lift from 2500 lb with sheave at ground level to 12,500 lb at maximum elevation, will body load 8500 lb, and handle side reach position loads up to 3500 lb.

CIRCLE (20) ON THE REPLY CARD



CONCRETE DRILLING MACHINES manufactured by New England Carbide Tool Company have carbide-tipped rotary bits ranging in size from 1½ to 8-in., that permit dry-drilling, vertically or horizontally, in hard concrete,—even when large stone aggregate and reinforcing rod are present. Operation with outrigger or jack-post mounting eliminates set-up and knock-down time, provides easy one-man handling, and requires no special operator skills. Bits have precision-ground cutting edges, multi spiral tip-to-shank flutes and removable shanks.

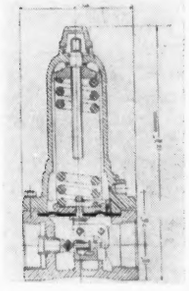
CIRCLE (21) ON THE REPLY CARD



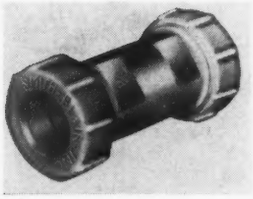
NEW COMBINATION PIPE-CLEANING AND TAPE-WRAPPING MACHINE, available from Tejas Plastics Materials Supply Company for sale or rental, handles 4, 6, 8, 10, and 12-in. pipe. About 18,000 ft of tape can be applied in an 8-hour day. Only 7-man crew, including side boom operator and foreman would be needed for the cleaning, wrapping, and lowering in, thus making "over the ditch" coating application very economical.

CIRCLE (22) ON THE REPLY CARD

NEW 2-IN. HIGH-PRESSURE FIELD REGULATOR being introduced by Rockwell Manufacturing Company completes its line of 141 regulators. Particularly useful along isolated gas transmission lines where industrial and domestic consumers require small volume service and must tap lines directly. Regulators are designed to handle primary cuts in pressure; has working pressure of 1500 psi, will withstand pressures on the outlet side up to this figure without damages. Unit has interchangeable orifices (7 sizes, ⅛ to ⅞) and springs to provide outlet pressures ranging from 5 to 400 psi.



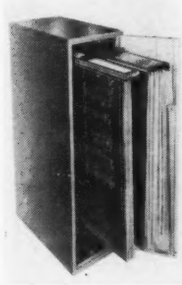
CIRCLE (23) ON THE REPLY CARD



COMPRESSION COUPLINGS FOR ½ THROUGH 2-in. iron pipe are now available from Smith-Blair, Inc. Couplings have high grade cast malleable iron sleeves in short or long lengths and end nuts, and are painted with a rust inhibiting blue lacquer. New line incorporates big coupling principles of design. Effectively seals new pipe as well as pipe that has a large degree of deterioration.

CIRCLE (24) ON THE REPLY CARD

FILE FOR MAPS, BLUEPRINTS. Plan Hold Corporation's new vertical file for single large sheets allows each sheet to be filed individually so it hangs flat and free from wrinkles or creases, ready for instant identification and use. File consists of wall-mounted bracket that holds up to 150 aluminum hangers. Tubular tape attached to sheet, allows it to be easily slipped on or off the hanger. In this way, 150 sheets of any length can be filed in only 12 lineal inches.



CIRCLE (25) ON THE REPLY CARD

Lancaster SYNTHETIC DIAPHRAGMS

UNSURPASSED

by any other material in any conditions of natural gas operations

MATERIAL DIFFERENCE

Basic material of the special Lancaster formula—Buna-N rubber—withstands roughest usage.

S-700-L SYNTHETIC DIAPHRAGMS for 1-A Sprague Gas Meters

HIGH FLEXIBILITY . . .
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LANCASTER SYNTHETIC DIAPHRAGMS ARE REINFORCED AT ALL FLEXING AND HINGING POINTS . . .
WITHSTAND EXCESSIVE FLEXING

NO FABRIC BREAKDOWN

Strength throughout! Cloth lining—the major point of failure—has been eliminated. No restrictions or leaks from fabric failure!

Use Lancaster S-700-L and S-7-L Synthetic Diaphragms with complete confidence in any natural gas operation. Not recommended for manufactured gas.

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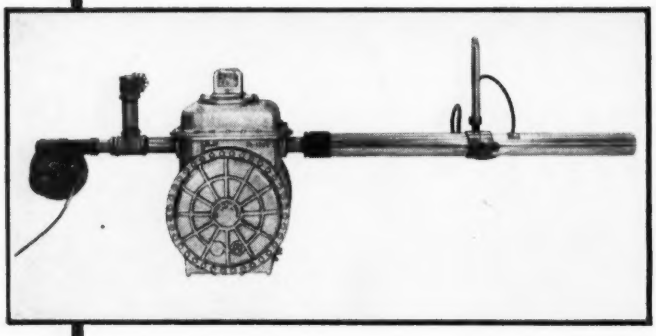
Manufacturers of Quality Parts for Gas Meters

POST OFFICE BOX 378 ○ LANCASTER, OHIO

Canadian Representative: Ontor Limited, Toronto 2, Canada

Prove Displacement Meters In the Field Quickly and Easily with AMERICAN® Flow Provers



Precision-built American Flow Provers provide quick and accurate proof testing of high capacity positive displacement meters in the field. Lightweight and portable, American Flow Provers are provided in 2, 3 and 4-inch models.

American Low Pressure Flow Provers, designed for hardcase displacement meter proof testing with air or gas at pressures below 15 psi, are supplied with calibrated orifice discs with proving rates to 10,000 cfh. Where gas cannot be conveniently discharged into surrounding atmosphere, a portable blower may be used.

American Critical Flow Orifice Provers, designed for 250 psi working pressure, are available with calibrated orifice discs for volumes to 6,000 cfh.

Consult your American representative for full information.

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PRODUCT PARADE

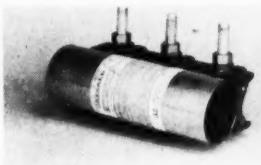
TRUCK BODIES manufactured by Reading Body Works, Inc. for service and installation departments feature removable and adjustable shelves and trays that give crewmen more flexibility to store and transport materials. Shelves and trays are mounted on special die-formed steel brackets and slip in and out easily. Dividers fit into three-dimensional slots to permit optional spacing on one-inch centers. Interior is equipped with brackets to hold gas meters, pipe racks are mounted on top of curb side compartments, and the floor of the body well is heavy duty safety plate.

CIRCLE (26) ON THE REPLY CARD

DIRECT LINE INTEROFFICE TELEPHONE COMMUNICATION with 20 preselected stations by push button, is now possible with equipment manufactured by Automatic Electric Company. Execcutive merely pushes a button to reach any one of 20 preselected P-A-X or P-A-B-X stations. Any standard telephone instrument or the Speakerphone — which enables users to converse without holding a handset — can be used with the new Executive Quick-Call direct line system, and telephone is in no way restricted to the 20 stations preselected for direct connection. Used independently of the pushbutton control cabinet, telephone can be dialed to connect with any station served by the P-A-X or P-A-B-X.

CIRCLE (27) ON THE REPLY CARD

DRESSER'S NEW SMALL-DIAMETER PIPE REPAIR CLAMP made of stainless steel and Grade A malleable iron lugs, provides easy-to-install, more efficient method of repairing full breaks or holes in asbestos-cement and cast iron lines. Besides being a clamp, unit can be used as a coupling. Odd lengths of plain-end cast iron pipe can also be coupled with the lugs on only one side. Clamp body is made of stainless steel which has yield strength factor of 2 to 1 over standard copper bands.



CIRCLE (28) ON THE REPLY CARD

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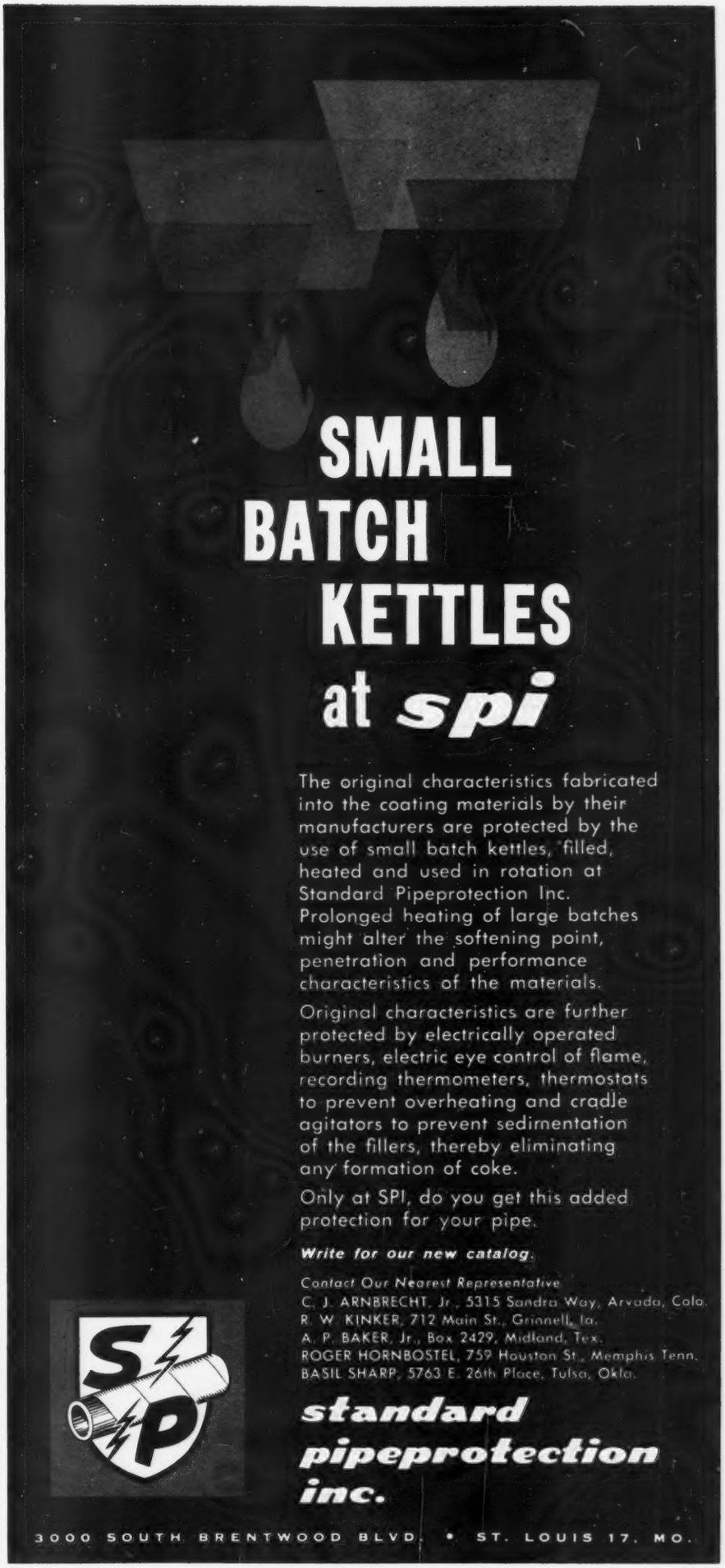
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BULLETIN BOARD

CATALOGS—BROCHURES—TECHNICAL DATA

FOUR NEW BULLETINS provide detailed information on American Meter Company products and their applications. Bulletin 400 describes pressure recorders and elements; bulletin 407, recording charts and planimeters; bulletin 408, temperature recorders and elements and bulletin 409, recording orifice meters with temperature recording element.

CIRCLE (61) ON THE REPLY CARD

WEED AND BRUSH CONTROL around utility meter stations, city gate stations and on rights-of-way with Diamond Line Rider formulations is described in a 4-page folder from Diamond Alkali Company. Formulations are based on herbicide groups—2,4-D and/or 2,4,5-T — to combine maximum killing power with optimum safety.

CIRCLE (62) ON THE REPLY CARD

IN GAS ANALYSIS, instruments alone are not enough: There must be adequate servicing, installation, and sampling system included in the instrument "package." As a result of this philosophy, Mine Safety Appliances Company engineers have developed a line of standard sample system components and accessories, for use with M-S-A infra red, thermatron, oxygen, combustible gas, water vapor and carbon monoxide analyzers. These sample systems, components, and filters are described in a new 8-page brochure.

CIRCLE (63) ON THE REPLY CARD

MODERN OFFICE COPYING TECHNIQUES are described in new 16-page booklet from Kodak. Entitled, "4 Versatile Office Time-Savers," booklet tells how organizations can save money and increase efficiency in purchasing, sales, administration, advertising, research, accounting, and engineering with modern office copying systems.

CIRCLE (64) ON THE REPLY CARD

DAVEY'S "AUTO-AIR" TRUCK-MOUNTED COMPRESSORS are described with photos, specifications, and installation drawings in new bulletin. Units are driven from truck engines through heavy-duty power take-offs that eliminate need for separate compressor engines; occupy less than one-third of truck body space, leaving room for men, tools, and materials. Five models are listed — 2 rotary type compressors delivering 125 and 160 cfm, and three piston type machines delivering 75, 125, and 160 cfm.

CIRCLE (65) ON THE REPLY CARD

PANEL CONTROL SYSTEMS for automatic gas, oil, or dual-fuel burners in commercial and industrial boiler installations are detailed in new folder from Iron Fireman. Dimensions, illustrations, special advantages, and selection chart for quick and easy specification of pre-wired, pre-tested panel assemblies are included.

CIRCLE (66) ON THE REPLY CARD

TWO NEW SETS OF COVERS OFFERED WITH A.G.A.'s latest supplement to the Gas Appliance Service Manual permit subscribers to divide the reference book into 3 looseleaf volumes on servicing of dryers, ranges, and water heaters and incinerators. Manual has been expanded from its original 400 pages to 750 pages and instructions are included for servicing both new and non-current gas appliances and controls. Descriptive folder with price schedules and order form is available from A.G.A. Utilization Bureau.

CIRCLE (67) ON THE REPLY CARD

BOOKSHELF

The Future Supply of Oil and Gas *by Bruce C. Netschert, published for Resources for the Future, Inc., by the Johns Hopkins Press, Baltimore 18, Maryland. Pages, 134. Price, $3.*

Primary contribution of this book is in establishing a "resource base" for the U. S. and adjacent continental shelf — about 1.2 quadrillion cu ft of natural gas and 500 billion bbl of crude oil. These quantities will not necessarily be discovered or extracted, but they are believed to exist as available for exploitation. Netschert's study of the availability of crude oil, natural gas, and natural gas liquids in the U. S. in the period through 1975 can not be directly compared with estimates of other authors who are concerned with "production" forecasts, as his estimates are only of "availability," not actual output. For example, in 1975, he estimates oil and gas availability could be about 22.5 trillion cu ft of natural gas per year, and 6 billion bbl of crude oil. Peak production capabilities in the U. S., however, will be less than this, and peak outputs probably will have been reached before 1975, and the production of oil and gas already on the downswing by that time. Data and methods used in Netschert's study embody research materials and approaches significant by themselves. He attempts to analyze the real variables — whether economic, technological, or geological — which will affect future availability of oil and gas, sets up new criteria for forecast projections, and avoids the mechanical extrapolation of trends characteristic of other studies of future oil and gas supplies.

The Properties of Gases and Liquids, *by Robert C. Reid, Thomas K. Sherwood, published by McGraw-Hill Book Company, 330 West 42nd Street, New York 36, New York. Pages, 386. Price, $10.*

Another in McGraw-Hill's series on chemical engineering, this book is intended to serve the practicing engineer, especially the process or chemical engineer. It is the first comprehensive critical review of the literature for methods of estimating and correlating various physical properties. Proposes a large number of methods for estimating physical properties of materials; and presents a critical review of various estimation procedures for limited number of properties of gases and liquids such as critical properties, P-V-T relationships, vapor pressure, latent heat of vaporization, heat of formation, etc. Book also makes recommendations regarding best methods of estimating each property and extrapolating available data.

ASTM Standards on Gaseous Fuels, *2nd Ed., compiled and published by American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pennsylvania. Pages, 204. Price, $3.*

Paperback book is a compilation of standards on gaseous fuels to succeed previous edition issued in 1954. Contains four methods for sampling and measurement and nine methods of testing and analysis. Of these, seven are new, revised, or have had their status changed since the last edition was published.

American Standard Installation of Domestic Gas Conversion Burners, Z21.8-1958, *4th Ed., available from American Gas Association Laboratories, 1032 East 62nd Street, Cleveland 3, Ohio. Pages, 72. Price, 35 cents each.*

Pocket-size (4 by 6-in.) standard contains provisions that have been reviewed and modified by subcommittee on listing and installation requirements for domestic gas conversion burners. Revised text has been approved as American Standard by American Standards Association, Inc.

Gas Equipment For Industrial Uses, *published by Industrial Gas Equipment Division of Gas Appliance Manufacturers Association, 60 East 42nd Street, New York 17, New York. Pages, 12. Price, $1.*

Up-to-date list of industrial gas equipment produced by reputable manufacturers pledged through a Code of Ethics to construct a product with superior design, workmanship, materials, and performance, is now available for possible distribution by gas utilities to municipal authorities, and industrial gas customers. Booklet lists names and addresses of 36 manufacturers with brief descriptions of the type of industrial gas equipment each produces. Also lists various types of equipped in alphabetical order.

The Oil Century, *by J. Stanley Clark, published by the University of Oklahoma Press, Norman, Oklahoma. Pages, 280. Price, $3.95.*

The story of oil and gas and the industrial and social transformation it has effected during the last 100 years since the first commercial oil well was completed near Titusville, Pennsylvania, is an interesting one, in itself, but the author has provided extra insight into this century by also tracing the course of production techniques from rank waste to conservation. It is a story of the quick grab for mineral riches; of unpredictable results in times when geology had as yet few or no applications; of wild-flowing wells, flaring gas, insufficient storage and pipeline facilities; of consolidations and mergers and small and large failures in the attempt to get the most out of the huge subterranean storehouse of oil and natural gas.

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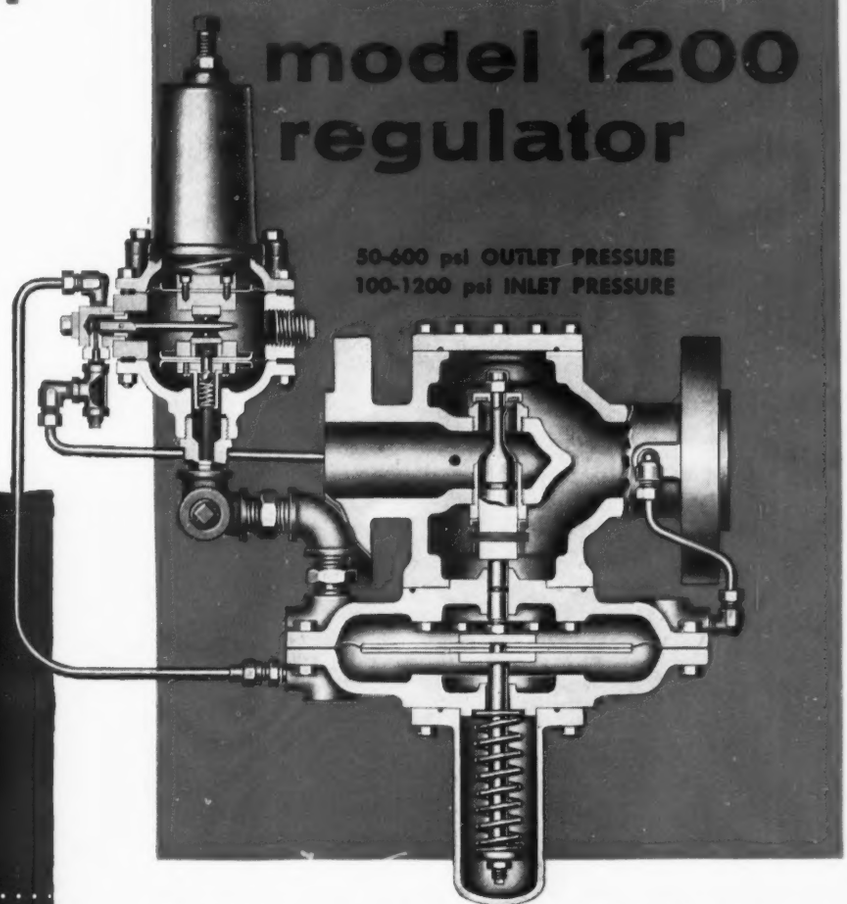

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- All-steel construction . . . stainless steel trim
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- Large capacities 529,000 cfh at 800 psi inlet

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Type 52 Pilot	50-300 psi
Type 53 Pilot	50-600 psi

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Series 60	10½"
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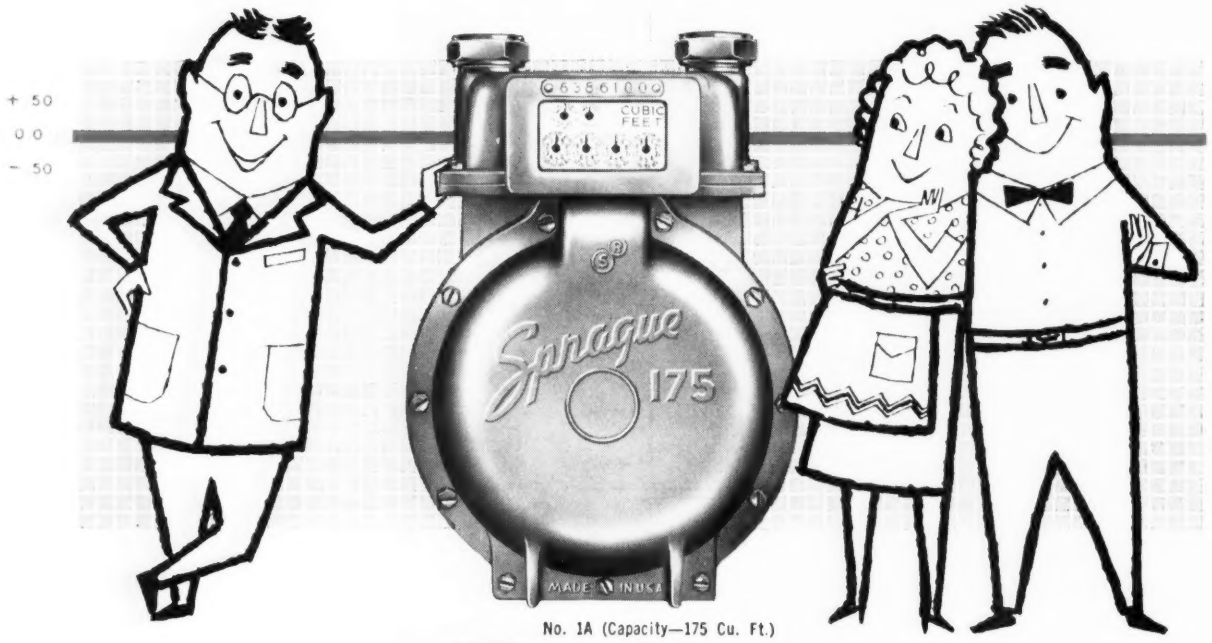

No. 1A (Capacity—175 Cu. Ft.)

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Compare and prove to yourself — the Sprague unique 3-chamber design, precision made cases, non-wearing valves, and extra-long life diaphragms all combine to practically eliminate friction, prevent seepage and insure faultless metering.

For complete details consult your Sprague representative.

The Sprague No. 175 is a good-looking Standard Domestic Meter of proven dependability. Small in size — Big in Capacity, it is accepted everywhere for its sustained accuracy, extended service, and low maintenance cost. Available in Iron Case or Aluminum Case. Sizes from 175 to 1,000 cu. ft. (Synthetic or leather diaphragms in sizes 175 & 240.)

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